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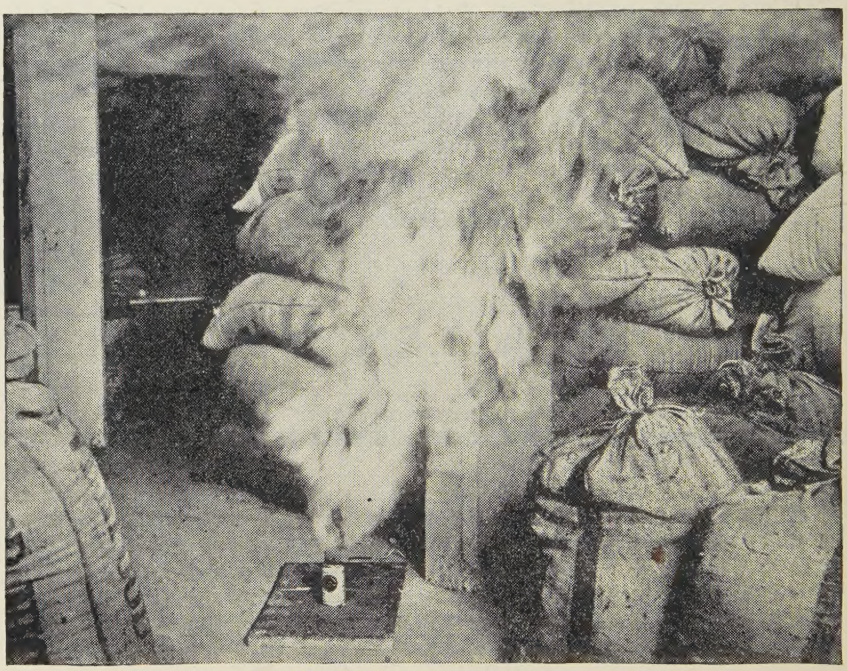

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DAVID (W. A. L.). **Air Transport and Insects of Agricultural Importance.**—11 pp., 42 refs. London, Commonw. Inst. Ent., 1949. Price 1*s.* 6*d.*

This review of the risks of transporting agricultural insect pests in aircraft and measures to prevent it is based on information available in the literature and elsewhere up to the end of 1948. The aspects considered are the factors influencing the entry of insects into aircraft, the importance of aircraft in relation to other means of distributing insects of agricultural importance, records of the occurrence of such insects in aircraft in various parts of the world, the treatment of aircraft with insecticides, and considerations relating to the choice of disinfestation methods and procedures.

The following is based largely on the author's summary and suggestions. Many kinds of insects enter aircraft and are able to survive long journeys. Serious pests have been found on numerous occasions, but apparently no major agricultural pest has been introduced into new territories in this way and become established, though there seems to be no reason why this should not occur, especially if spraying and quarantine regulations were relaxed. Spraying is more effective in controlling insects in aircraft than fumigation or dusting. Light spraying when the passengers are on board is fairly satisfactory against mosquitos, but for more resistant insects, a heavy spray applied when the machine is empty to build up a lasting toxic deposit is also necessary. Even this may not kill all insects, but further measures do not appear feasible with the methods at present available. The procedure suggested is that DDT, probably in aqueous emulsion, should be sprayed over all the aircraft interior and furnishings so as to build up the toxic deposit. This should be supplemented by the use of an aerosol to give a rapid knockdown of the more susceptible insects, which would apparently be best applied after the luggage is in the aircraft and just before the passengers enter. Highly infested freight should be treated before it is loaded. Disinfestation can be facilitated by designing the interior of the aircraft to eliminate dark, sheltered places in which insects can rest, and utilising, wherever possible, fabrics and fibrous insulating material that have been impregnated with DDT: if the interior finishes are well chosen, they will retain the insecticide and can be sprayed with more DDT. Disinfestation is obviously necessary only where the insect populations at two ports of call are different or if an insect-borne disease occurs at one only. The procedure employed will depend on what insects must be prevented from spreading.

ZIMMERMAN (E. C.). **Insects of Hawaii. A Manual of the Insects of the Hawaiian Islands, including an Enumeration of the Species and Notes on their Origin, Distribution, Hosts, Parasites, etc. Volume 1. Introduction.**—xx, [1+] 206 pp., 53 figs., 13 pp. refs. Honolulu, Univ. Hawaii Press, 1948. Price $3.50. **Volume 2. Apterygota to Thysanoptera, inclusive.**—viii, [1+] 475 pp., 228 figs., many refs. Price $5.50. **Volume 3. Heteroptera.**—[9+] 255 pp., 110 figs., 6½ pp. refs. Price $4.50. **Volume 4. Homoptera: Auchenorhyncha.**—vii, [1+] 268 pp., 92 figs., 5½ pp. refs. Price $4.50. **Volume 5. Homoptera: Sternorhyncha.**—vii, [1+] 464 pp., 239 figs., 13½ pp. refs. Price $6.00. Price of 5 vols., £6.

The first of these five volumes, which form part of a comprehensive general work on the insects of Hawaii, contains accounts of the geological history of Hawaii and its influence on the flora and fauna and of the possible ways in which the endemic fauna may have developed from ancestral immigrants, a discussion of the dispersal methods available for such immigrants, and analyses and summaries of the endemic insect fauna showing the zoogeographical regions in which it originated, with, for comparative purposes, similar analyses of

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endemic land snails, birds and plants, the last by F. R. Fosberg. The other four volumes contain annotated systematic lists of the Hawaiian species of the major groups with which they deal, and each list is preceded by a general account of the group and includes keys to the families, genera and species. The information given for each species comprises its distribution and status (endemic or immigrant) in Hawaii, its food-plants, hosts or habitat, and, where possible, its Hawaiian name and notes on its life-history and habits, with, for those that are pests, indications of the way in which they are injurious and methods of control. Some new species are described ; most of them are Coccids, and these are described by G. F. Ferris. A bibliography is given for each order or suborder, and each volume includes a check list of the species dealt with in it. There is a key to the orders represented in Hawaii in the second volume, and the five volumes together contain several thousand illustrations of a quality that greatly enhances their value.

FULMEK (L.). **Etwas über Hyperparasiten.** [A Note on Hyperparasites.]—*Zbl. GesGeb. Ent.* **1** pt. 4 pp. 97–106. Lienz, 1946.

About 10 per cent. of all the known species of parasitic insects are hyperparasites. Hyperparasites that develop on the primary parasites of insect pests are economically harmful, but some of these also act as primary parasites and are of value as such. Since little is known of the groups concerned and the host range of the individual species, the author presents a preliminary survey based on published and other sources. The first part consists of a summary of the relative frequency with which species of different families or other groups of parasitic insects are hyperparasites or are themselves parasitised, a list showing the numbers of different parasite hosts of a large number of species of hyperparasites, and a discussion of the data shown in it. The second part consists of lists of the genera and species of hyperparasites arranged according to the orders or families of their parasite hosts.

SCHAERFFENBERG (B.). **Bodenentseuchung durch Ueberschwemmung.** [Disinfestation of the Soil by Flooding.]—*Zbl. GesGeb. Ent.* **2** pt. 1 pp. 48–51, 13 refs. Lienz, 1947. **Grossversuch zur Bekämpfung des Maikäferengerlings durch Sommerüberschwemmung.** [Large Scale Experiment in the Control of Cockchafer Larvae with Summer Flooding.]—*T.c.* pp. 51–53, 3 refs.

In the first of these papers, the author reviews literature showing that flooding is of value against wireworms and the larvae of *Melolontha* spp. in summer [*cf. R.A.E.*, A **26** 521], but not at other seasons of the year. Experiments by the author with the larvae of numerous soil insects have confirmed this for species that live in light dry soils, the reason being that such insects swell on immersion in water and are then susceptible to attack by decay organisms, which are active at the higher temperatures prevailing in summer and kill them within a week. Swelling has no harmful consequences at other seasons, and does not occur at all in winter or in larvae that inhabit wet soils. Temporary flooding in summer should therefore control wireworms and *Melolontha* in dry or semi-dry soils.

In the second paper, the information contained in the first is repeated with special reference to larvae of *Melolontha* and a brief account is given of an experiment against them in the summer of 1944 in southern Moravia in grassland covering nearly 75 acres. The soil was sand or a mixture of humus and sand and contained 27–76 larvae per sq. yard, nearly all full-fed and ready to pupate ; the level of the subsoil water was high. The land was flooded

at the beginning of July, after the first mowing, and was left under water for eight days, during which the temperature fluctuated between 21 and 27°C. [69·8–80·6°F.] and the sky was cloudy. The results were estimated at the beginning of September by digging in 20 places for young adults. Only three were found, each in a separate soil sample, as compared with 2–5 larvae in each sample taken before the flooding.

PERROT (E.) & others. **Manuel de phytopharmacie. Tome III.**—[4+] 409 pp., 68 figs., refs. Paris, Masson et Cie, 1949. Price *Fr.* 900.

This last volume of three dealing with plant protection in France [*cf. R.A.E.*, A **37** 142] is devoted almost exclusively to chemical control. It is in two parts, of which the first, by R. Fabre and Y. Raoul (pp. 1–324) contains a comprehensive account of the composition, preparation, properties, methods of analysis, and uses of numerous chemicals, chiefly insecticides and fungicides, the precautions to be observed during their application, and the antidotes in cases of human poisoning. In the second part, A. Desrue (pp. 325–398) reviews various methods of physical and chemical control, describes equipment for the application of sprays and dusts and indicates some of the factors to be considered in determining the most suitable method for any given case.

STRAWIŃSKI (K.). **Ochrona roślin.** [Plant Protection.]—$9\frac{1}{4} \times 6\frac{3}{4}$ ins., 504 pp., 294 figs., 18 refs. Warsaw, Państw. Inst. Wydawn. roln., 1949.

This text-book of plant protection in Poland is divided into an introductory part in which the characteristics of the chief groups of pests and diseases of plants are reviewed and the various types of control measures discussed, and a special part, which comprises most of the book and is devoted to a large number of individual pests and diseases arranged under field and vegetable crops, fruit trees and bushes, stored grain, and ornamental plants. The pests dealt with in it are largely insects, and information is given on their appearance and bionomics, the damage they cause and methods of control. In the final sections of this part, the wild plants that serve as alternative hosts of pests and diseases are discussed, suggestions are made for amplifying school studies of plant protection, and directions are given for the collection of field data and the despatch of specimens for identification.

HARRIS (W. V.). **The Banana Borer.**—*E. Afr. agric. J.* **13** no. 1 pp. 15–18, 5 figs., 8 refs. Nairobi, 1947.

The author gives a brief review of the distribution of the banana borer, *Cosmopolites sordidus*, Germ., with special reference to Africa, in the course of which he states that he identified it from Zanzibar in 1945, and describes its development in the banana plant, the effects of infestation and methods of control. In Uganda, the egg, larval and pupal stages last 5–8, 14–21 and 5–7 days, respectively, and the adults are believed to survive for two years. Infestation can be prevented or reduced by using uninfested planting material, careful planting [*cf. R.A.E.*, A **27** 346], the elimination of breeding places such as spent stems on the plants, old stems on the ground or exposed cut surfaces of rhizomes [*cf.* **26** 210], and the distribution of traps [*cf.* **33** 365]. Brief notes on the natural enemies of the weevil are given. Attempts to introduce the predator, *Plaesius javanus*, Erichs., into Uganda proved unsuccessful [*cf.* **36** 367].

Moutia (L. A.) & Mamet (R.). *Clemora smithi* (**Arrow**) **un ennemi de la canne à sucre à l'Ile Maurice.**—*Bull. Dep. Agric. Mauritius* Sci. Ser. no. 28, [3+] 7 pp., 8 pls. (2 fldg.), 8 refs. Port Louis, 1947.

Clemora smithi, Arr., has been a pest of sugar-cane in Mauritius for over 30 years and was probably introduced from Barbados about 1906. The eggs are deposited in the soil, and the larvae feed on the roots of the canes, sometimes destroying them completely and causing up to 10–15 per cent. loss of crop. Young canes with imperfectly developed root systems suffer most. The egg, larva and adult of this Melolonthid are described. The duration of the egg stage ranges from seven days in December or January, if temperature and soil humidity are high, to 15–23 days under less favourable conditions. The larval and pupal stages last 7–9 months and 18–25 days, respectively, and the adults survive for 5–7 months. In addition to feeding on the roots of sugar-cane and grasses, the larvae also attack those of maize, peas, beans, potatoes and cassava [*Manihot utilissima*]. They are favoured by friable humid soils rich in humus. The adults hide in the ground at a depth of 6–8 inches during the day and fly at night. They are present throughout the year, but emerge in numbers between October–November and March–April, chiefly after heavy rainfall in November or December. The oviposition period begins 3–4 months after emergence and lasts 3–4 months, each female depositing about 60 eggs at a depth of 3–4 inches.

Hand collection of larvae and adults was formerly used as a control measure, but has been abandoned as ineffective [*cf. R.A.E.*, A **24** 666; **35** 1, etc.]. Ploughing before planting and similar soil treatments destroy an average of 60 per cent. of the larvae, but planting the cane in infested ground between July and September is the most important cultural method of control, since such plants are not attacked until March or April, when they have a well developed root system. Many fumigants have been tested against the larvae, but have given poor results and are expensive. The chief parasites of the larvae in Mauritius are *Tiphia parallela*, Smith, and species of *Campsomeris* [*cf.* **36** 209, etc.], which have life-cycles of 60 and 38–40 days, respectively, and are present in practically all heavily infested plantings. The multiplication of these Scoliids can be increased by encouraging the flowering plants that provide food for the adults [*cf.* **26** 317]. A key is given to the females of *T. parallela*, *C. coelebs*, Sichel, *C. erythrogaster*, Dalm., *C. lachesis*, Sauss., *C. phalerata*, Sauss., and *C. pilosella*, Sauss., and one to the males (in which *C. phalerata* is given as *C. pilosella*). The introduction of additional parasites, such as Tachinids that attack the larvae and adults, is considered desirable. Certain varieties of sugar-cane produce primary roots at intervals over a period of time instead of all at once, and thus have more opportunity of resisting attack by *Clemora*; the growing of one such variety (M.134/32) is recommended, and three other promising varieties that are still too new to be recommended definitely are named.

Plackett (R. L.) & Hewlett (P. S.). **Statistical Aspects of the independent joint Action of Poisons, particularly Insecticides. I. The Toxicity of a Mixture of Poisons.**—*Ann. appl. Biol.* **35** no. 3 pp. 347–358, 7 figs., 14 refs. London, 1948.

Bliss's statistical treatment of the hypothesis of the independent joint action of poisons [*R.A.E.*, A **28** 199] is extended and revised. He did not consider the possibility of negative correlation in resistance, in which the individual insects that are more resistant to one poison are less resistant to the other, and the correlation coefficient employed by him cannot be applied

to it. The bivariate normal correlation coefficient is shown to provide a good measure, whether the correlation is positive, negative or absent. The characteristics of the dosage mortality curve for a mixture of poisons the resistances to which are log-normally distributed are described. In a discussion of whether a mixture of poisons is more toxic if they act similarly or independently, it is concluded that there is no general rule.

PARR (H. C. M.) & BUSVINE (J. R.). **A Spinning-disk Sprayer for applying residual Insecticides.**—*Ann. appl. Biol.* **35** no. 3 pp. 359–368, 5 figs., 2 refs. London, 1948.

The following is almost entirely the authors' summary. In view of the need in laboratory tests of persistent synthetic insecticides for convenient and reliable equipment for applying standard deposits to various surfaces, an apparatus employing the spinning-disk principle [*cf. R.A.E.*, A **37** 20] was used. It consists essentially of a spinning disk that throws off liquid, applied to its centre, in the form of small droplets. These are of the same order of size (about 0·1–0·4 mm. in diameter) as those produced by knapsack sprayers, which are most satisfactory for applying persistent insecticides to walls and similar surfaces, but they are more uniform and consistent. The sprayer can be used to coat various surfaces, up to 1 ft. square, with deposits of insecticides in oil solution or in aqueous suspensions or emulsions. The deposits can be controlled and estimated with a fair degree of precision.

BROADBENT (L.). **Aphis Migration and the Efficiency of the Trapping Method.**—*Ann. appl. Biol.* **35** no. 3 pp. 379–394, 5 figs., 21 refs. London, 1948.

The factors that affect the numbers of Aphids caught on adhesive traps were investigated in a potato field at Rothamsted in southern England during 1947, and the following is substantially the author's summary of the findings. From the similarity of results obtained from traps at the same height (2–14, 32–44 or 62–74 ins.) above the ground in different parts of the field, it is concluded that the total catches, as well as the catches of a single species (*Myzus persicae*, Sulz.), in different localities in different seasons can justifiably be compared. During the summer dispersal flights, different species flew at different heights, so that traps at one height only are not suitable for comparing the abundance of different species. There was less variation in numbers caught on traps at a height of 3–4 ft. above the ground than on traps at 5–6 ft. or at ground level. During the first fortnight of July, an estimated average of 200 Aphids, 1·6 per cent. of which were *M. persicae*, was caught on the lowest traps, which occupied the position of the potato plants. Most of these were not potato Aphids, but it is suggested that some of them might act as vectors of potato viruses, in the course of testing the plants for feeding purposes. The number of Aphids caught was roughly proportional to the volume of free air space around the traps, and as the foliage increased in density, the numbers caught on lower traps decreased in proportion.

Wind-speed records within and above the crop are discussed, and it is shown that conditions are often suitable for voluntary flight in and near the crop on relatively windy days. Comparisons of the catches on the half of each trap facing the wind with those on the other half showed that voluntary flight decreased with increasing height. When coated with adhesive grease, brilliant yellow traps caught more Aphids than white traps, which in turn caught more than black ones.

Broadbent (L.) & Gregory (P. H.). **Experiments on the Spread of Rugose Mosaic and Leaf Roll in Potato Crops in 1946.**—*Ann. appl. Biol.* **35** no. 3 pp. 395–405, 5 figs., 7 refs. London, 1948.

The following is almost entirely the authors' summary. A series of experiments on the spread of potato rugose mosaic (virus Y) and leaf-roll, which has been in progress on a uniform plan since 1943, was ended in 1946. The results obtained up to 1945 have already been published [*R.A.E.*, A **37** 90]. Mean values for 13 centres in England and Wales showed that in 1946, 69 per cent. of the infections with virus Y and 48 per cent. of those with leaf-roll reached the tubers of Majestic potatoes by the beginning of August. There was usually little subsequent increase of rugose mosaic, but a late increase of leaf-roll was associated with a relatively high initial spread. Three-quarters of the virus-Y and over half the leaf-roll infections occurred within a distance of five plants from the source. There was no close correlation between the spread of either virus and the maximum number of *Myzus persicae*, Sulz., either apterous forms on the plants or alates caught on adhesive traps, but centres with high trap catches in July and August showed pronounced late-season spread of leaf-roll. A comparison of the amount of spread of the two viruses from the source of infection during the three seasons indicated that it is less extensive at the end than at the beginning of the season, either because late infection is due largely to apterae or because the alates do not in general fly so far late in the season as they do earlier.

Gregory (P. H.). **The Effect of Roguing on the Spread of Virus Diseases in Potatoes at Rothamsted in 1946.**—*Ann. appl. Biol.* **35** no. 3 pp. 406–411, 2 figs., 2 refs. London, 1948.

The following is virtually the author's summary. Experiments on roguing virus-diseased plants from plots of Majestic potatoes, which have been in progress at Rothamsted since 1943 [*cf. R.A.E.*, A **37** 91–92], were continued in 1946. Plots were rogued in mid-June and early and late July, and plants were lifted from them at the end of July, August and September. Roguing had little effect in reducing the spread of rugose mosaic (caused by potato virus Y) [*cf. loc. cit.*]. The spread of leaf-roll was reduced to half that on unrogued plots by roguing on 14th June. Later roguing did not reduce the spread of leaf-roll, unless combined with early lifting. Early lifting increased the effect of early roguing. In spite of these results, roguing main crop potatoes in the south of England is not considered a practical control measure.

Uvarov (B. P.). **The Migratory Locust in England in 1946.**—*Proc. R. ent. Soc. Lond.* (A) **22** pt. 4–6 pp. 35–37, 1 map, 4 refs. London, 1947.

During August–October 1946, individuals of *Locusta migratoria*, L., were reported in Jersey, the Isle of Wight and seven places on the south coast of England, at one of which a group of nine was observed. All of eight specimens available for study were females in the gregarious phase. The length of their elytra (44–47·7 mm.) differed from that (49–59 mm.) of the gregarious phase of subsp. *migratoria*, L., which often reaches England from its outbreak centres on the Black Sea [*R.A.E.*, A **29** 322], but was comparable with the average (45·7 mm.) of this phase of the race that appeared in swarms in the Landes region of south-western France in 1945 [**35** 377]. Locusts in the Landes region became very numerous in 1946, and large swarms left in early August, flying chiefly northwards, but also to the west ; isolated individuals were caught in France as far north as the departments of Seine et Oise and La Manche, and some evidently reached England. One female taken in England was reported

to have oviposited in captivity, and the ovipositor of another was smeared with the secretion exuded during egg-laying, but it is considered improbable that eggs would survive the mild, humid English winter.

BARNES (H. F.). **Periodic Fluctuations in the Prevalence of the Wheat Blossom Midges.**—*J. Anim. Ecol.* **16** no. 1 pp. 74–75, 1 fig., 6 refs. London, 1947.

Observations on the apparently periodic fluctuations in the numbers of *Contarinia tritici*, Kby., and *Sitodiplosis mosellana*, Géh., in a field of permanent wheat at Harpenden [*cf. R.A.E.*, A **30** 90, etc.] were continued in 1941–46, and the data for the whole 20 years since the work began are here presented. Investigations on delayed emergence [*cf.* **32** 225] have now shown that larvae of the two species can give rise to adults after spending three and seven winters in the soil, respectively. Major peaks in the combined larval population per 500 ears of wheat occurred in 1931 and 1946 and minor ones in 1935 and 1941, with corresponding troughs in 1927, 1933, 1938 and 1944. The two species considered separately showed the same population trends, with almost identical peak and trough years. The results for the whole period fit in well with the original hypothesis of peaks every 4–6 years, separated by troughs [*cf.* **30** 91].

MATTHÉE (J. J.). **Phase Variation in the Lawn Caterpillar** (*Spodoptera abyssinia* **Guen.**).—*J. ent. Soc. sthn Afr.* **10** no. 1 pp. 16–23, 4 refs. Pretoria, 1947.

In view of evidence of the occurrence of phase variation in larvae of *Laphygma* spp. [*R.A.E.*, A **32** 284, 285; **34** 47; **37** 170] and possibly *Spodoptera abyssinia*, Gn. [*cf.* **32** 286; **34** 47], three successive generations of the latter species were reared in Pretoria during 1943–44 from a mixed population of *gregaria* and *transiens* types collected in the field, and lines showing the coloration characteristic of *gregaria*, *transiens* and *solitaria* types were maintained in isolation or in crowds. Of a total of 700 larvae reared in six separate crowds, 54·1 per cent. were classified as *gregaria*, 44·1 per cent. as *transiens* and 1·8 per cent. as *solitaria*, whereas the corresponding percentages of 477 reared in isolation were 0·3, 50·7 and 49. Statistical analysis showed that the distribution of the three types differed significantly in the two series, and it is therefore concluded that phase variation occurs in this species. The percentage of larvae with characteristic coloration was significantly increased by rearing *solitaria* types continuously in isolation for three generations, the maximum increase occurring in the F_2 generation, but not by rearing *gregaria* types continuously in crowds, when the highest percentage showing *gregaria* coloration was 59·8 in the F_3 generation. There was no difference in the duration of the life-cycle of *solitaria* and *gregaria* types, the periods required being 26–31 and 28–31 days, respectively, at 90°F. and 50 per cent. relative humidity. Most of the larvae reared in crowds passed through six instars, but only 41·7 per cent. of those reared in isolation did so, the rest passing through five.

HESSE (A. J.). **A remarkable new dimorphic Isometopid and two other new Species of Hemiptera predaceous upon the Red Scale of** *Citrus*.—*J. ent. Soc. sthn Afr.* **10** no. 1 pp. 31–45, 2 figs., 23 refs. Pretoria, 1947.

Collections of Hemiptera found preying on the red scale [*Aonidiella aurantii*, Mask.] on *Citrus* at Letaba in the Northern Transvaal in 1944 and 1946 included nymphs and adults of an Isometopid, the first of its family to be recorded

from Africa. It is described from adults of both sexes as *Letaba bedfordi*, gen. et sp. n. ; descriptions are also given of the nymphs and one of the shrunken eggs seen in the dried abdomen of a female, and of the characters of the genus and family. There appear to be at least five nymphal instars. *L. bedfordi* was always found on heavily infested trees, but was relatively scarce, except on a group of trees that were not fumigated, on which it increased rapidly during winter and early summer and controlled the Coccid. The other new species are the Lygaeid, *Geocoris liolestes*, and the Anthocorid, *Orius* (*Triphleps*) *cocciphagus* ; they are described from adults of both sexes and males, respectively, and were also found preying on *A. aurantii* at Letaba.

Ullyett (G. C.) & v[an] d[er] Merwe (J. S.). **Some Factors influencing Population Growth of** *Ephestia kühniella* **Zell. (Lep., Phycitid).**—*J. ent. Soc. sthn Afr.* **10** no. 1 pp. 46–63, 5 figs., 9 refs. Pretoria, 1947.

In continued work on the improvement of methods for the large-scale rearing of *Ephestia kuehniella*, Zell., in South Africa [*R.A.E.*, A **37** 54], data were obtained on the influence of the quantity and composition of the medium on the growth of the larvae and of the quantity on the fecundity of the moths to which they give rise. To test the effect of its composition, the larvae were reared at 75°F. in batches of 75 in 1-lb. honey jars containing 20 gm. medium and with screw tops that were kept closed to prevent parasitism by *Bracon* (*Microbracon*) *hebetor*, Say. The larval stage lasted eight weeks, and since observations on weight were made weekly, eight jars were used for each replicate, and a different one was examined each week to avoid interference with development by the frequent destruction of the silken tubes in which the larvae feed. The media tested were flour, bran, mixtures of the two, and a mixture of flour and sawdust (1 : 1), which was included to show whether bran has a food value for the larvae or only affects the consistency of the medium. The larvae reared in this medium were the lightest, and those reared in pure flour and pure bran the next so. Three mixtures of flour and bran (3 : 1, 1 : 1 and 1 : 3) were more favourable, and two (2 : 1 and 1 : 2) the most so. The differences between these groups were significant. The product known in South Africa as No. 1 unsifted wheaten meal, which contains approximately three parts flour and one part bran by weight, is thought to provide a good average medium.

In experiments on the effect of density, populations of 100–800 larvae were reared in 37 gm. no. 1 unsifted wheaten meal until adults began to emerge. The existence of a high correlation between density and total mortality was demonstrated. The latter increased rapidly when less than 0·1 gm. meal was available per larva, reached 50 per cent. when there was only 0·046 gm., and was correlated with reduction in size of the adults produced. The sex ratio was not influenced by larval density. Females that were small as a result of overcrowding contained fewer eggs than normal ones, and comparatively small differences in size produced marked differences in fecundity. It is concluded that where stocks of *E. kuehniella* are being raised and it is desirable to ensure the maximum egg-production from the smallest amount of meal per larva, 0·074 gm. meal should be provided for each larva. Mortality at this density is about 35 per cent., however, and if the larvae are being used as hosts for parasites, rather more meal should be given to reduce it. In practice, the same stocks are used for both purposes, and a quantity of meal slightly in excess of 0·074 gm. per larva gives generally satisfactory results. The ways in which the medium available for food and oviposition [*loc. cit.*] influences the course of infestations in meal stored under different conditions is discussed, with some reference to general theories of population growth.

Geyer (J. W. C.). **A Study of the Biology and Ecology of** *Exochomus flavipes* **Thunb. (Coccinellidae, Coleoptera). Part II.**—*J. ent. Soc. sthn Afr.* **10** no. 1 pp. 64–109, 9 figs., 10 refs. Pretoria, 1947.

This second part of a paper on the bionomics of *Exochomus flavipes*, Thnb., in South Africa [*cf. R.A.E.*, A **37** 265] contains an account of experiments on the effect of humidity and temperature on it and studies of field populations, together with a summary of the whole of the work. Atmospheric humidity was found to have no significant effect on adult survival and fecundity, the pre-oviposition period or the development of the immature stages. Oviposition ceased and the duration of the development stages and of adult life were prolonged at mean temperatures below 60°F. Optimum temperatures for development, oviposition and adult survival were between 65 and 86°F. At a constant temperature of 96°F., adult life was shortened, eggs and larvae died and oviposition did not take place.

This predator and *Cryptolaemus montrouzieri*, Muls., were approximately 1½ times and twice as numerous on segments of prickly-pear (chiefly *Opuntia megacantha*) that were heavily infested with *Dactylopius opuntiae*, Ckll., at one place at which observations were made and approximately three and 4½ times as numerous at another. High summer temperatures at the first of these places inhibited reproduction by *E. flavipes*, which was there most abundant during June–August, but its numbers at the other were not affected by climate. Quantitative data on emergence, parasitism by other insects and pupal mortality were obtained by collecting pupae monthly over a period of a year at four places with different climatic conditions. The percentages of the total numbers of pupae collected at each place from which adults emerged varied from 40·1 to 66·8, and the fluctuations due to parasitism and high temperatures at each are discussed. Maximum monthly emergence varied from 66·9 to 79 per cent. and minimum monthly emergence from 16·5 to 39·1 per cent. Notes are given on the appearance, incidence and importance of the four parasites reared from the pupae [**37** 266]. Of these, *Homalotylus* sp. and its parasite, *Pachyneuron* sp., were not numerous [*cf. loc. cit.*]. *Cheiloneurus* sp. occurred in 9·2 per cent. of the pupae collected over the year at one place ; its seasonal fluctuations indicated that it reaches maximum efficiency only where the host is abundant. As many as 16 individuals were reared from a single host, but attempts to induce it to attack pupae in the laboratory were unsuccessful. Females of the other Encyrtid, *Ooencyrtus* sp., readily attacked pupae of *Exochomus* in the laboratory, and as many as 14 examples were reared from a single host. This species was not reared from hosts containing *Cheiloneurus*, and appears to be slightly more efficient than that parasite at low host densities. The percentage of pupae containing dead immature parasites of any species during the year varied from 3·7 to 4·7 at three of the places, but was 9·4 at the fourth, apparently owing to climatic extremes. The total percentage parasitism of pupae averaged 23·7, 51·4 and 31·9 at three of the places and varied from 11·5 to 78 at the fourth. Some pupae were killed by other factors, and the total percentages of pupal mortality at the four places were 33·1, 44·7, 59·8 and 58·3, respectively.

Sailer (R. I.). *Dysdercus bimaculatus* **Stål, 1843, restored (Hemiptera, Pyrrhocoridae).**—*Proc. ent. Soc. Wash.* **49** no. 1 pp. 15–19, 4 figs., 5 refs. Washington, D.C., 1947.

Stål considered *Dysdercus bimaculatus*, which was described by him from San José, off the West coast of Panama, to be identical with *D. obliquus*, H.-S., which was described from Mexico, and his opinion was subsequently followed. It recently became apparent, however, that *D. obliquus* as now recognised is

composed of two species, and since both attack cotton in Central America, an attempt was made to clarify the position. A comparison of sketches of the genitalia and pronota of the two forms with the type series of *D. bimaculatus* showed that a specimen from Barro Colorado Island, Panama Canal Zone, agreed with these types. The type of *D. obliquus* was not seen, but on distributional evidence it represents the other form, so that *D. bimaculatus* becomes a good species. According to specimens in the U.S. National Museum, both species extend from Mexico to Panama and *D. bimaculatus* also to Colombia and Venezuela. The latter is predominantly the more southern in distribution, with records from 25 localities in central America, Columbia and Venezuela and only six in Mexico, while *D. obliquus* has 13 localities in Mexico and only seven in central America. The more southern species showed a wider range of variation in the shape of the spots on the hemelytra, only 11 out of 190 specimens agreeing with Herrich-Schäffer's illustration of *D. obliquus*, as compared with 48 out of 52 of the predominantly Mexican form. Characters separating the two species as illustrated, and the locality records of the Museum specimens and lists of references to the literature that apparently apply to each species are given ; these include one from Venezuela already noticed [*R.A.E.*, A **30** 315] in which *D. bimaculatus* is cited as *D. obliquus*.

Black (L. M.) & Oman (P. W.). **Parthenogenesis in a Leafhopper,** *Agallia quadripunctata* **(Provancher) (Homoptera : Cicadellidae).**—*Proc. ent. Soc. Wash.* **49** no. 1 pp. 19–20, 2 refs. Washington, D.C., 1947.

Since males of *Agallia quadripunctata*, Prov., are rare, experiments were carried out to determine whether this Jassid reproduces parthenogenetically. A population derived from nymphs collected in Washington, D.C., that was maintained on crimson clover (*Trifolium incarnatum*) in cages for over two years consisted only of females ; 29 nymphs reared in isolation all gave rise to females, and the latter oviposited in clover without contact with other individuals. It is therefore concluded that parthenogenesis in this species is probably normal in the eastern United States. This appears to be the first authentic record of it in auchenorrhynchous Homoptera.

Buchanan (L. L.). **Hickory Curculios of the Genus** *Conotrachelus* **(Coleoptera : Curculionidae).**—*Proc. ent. Soc. Wash.* **49** no. 2 pp. 41–54, 47 figs. Washington, D.C., 1947.

A key is given to the adults of the six species of *Conotrachelus* that are associated with species of *Carya* (*Hicoria*) in the United States, together with collection records based largely on specimens in the U.S. National Museum. They are *Conotrachelus elegans*, Say, bred from *Phylloxera* galls on pecan (*Carya pecan*) ; *C. affinis*, Boh., and *C. hicoriae*, Schoof, larvae of both of which were found in nuts of shagbark hickory (*Carya ovata*) and of the latter also in those of pecan ; and *C. aratus*, Germ., larvae of which occurred in pecan shoots, *C. tibialis*, Schoof, a larva of which was found in a hickory leaf stem, and *C. pecanae*, sp. n., which is described from adults taken from under the rough bark of pecan in Louisiana. Further adults of *C. pecanae* were taken on pecan and other trees in Louisiana and Texas, and larvae were found in pecan shoots in Louisiana. The combined range of these species extends over the eastern half of the United States and into southern Canada, and two or more frequently occur in the same general region. *S. juglandis*, Lec., is occasionally recorded from hickory, but its occurrence on plants other than *Juglans* is probably accidental or exceptional.

FRIEND (R. B.). **Connecticut State Entomologist, Forty-fifth Report, 1945.**— *Bull. Conn. agric. Exp. Sta.* no. 501, 116[+2] pp., 19 figs., refs. New Haven, Conn., 1946.

R. B. Friend (pp. 9–17) gives a short survey of insect pests and records of their abundance in Connecticut during the year ending 31st October 1945. They included adults of Brood II of *Magicicada septendecim*, L., which appeared 17 years after their last appearance, in about the same part of the State; they were observed from 22nd May to 9th July and caused severe injury to apple, peach, elm, oak, maple, birch and other trees and shrubs by slitting the twigs for oviposition, thus rendering them liable to break. M. P. Zappe and L. A. DeVaux (pp. 17–20) summarise the results of the annual inspection of nurseries for pests and diseases; it covered 302 properties and showed that the pine leaf scale [*Phenacaspis pinifoliae*, Fitch] was present in only 12 nurseries, instead of 53, as in 1944, possibly owing to the reduction in numbers of mugho pine [*Pinus mugo*], and that the oyster-shell scale [*Lepidosaphes ulmi*, L.] was present in 66 nurseries and Dutch elm disease, caused by *Ceratostomella* (*Graphium*) *ulmi*, in or near seven. *L. ulmi* was particularly abundant on willow, poplar, ash, lilac and older fruit stock, but was seldom found on fruit stock less than three years old. In an account of work connected with the control of *Lymantria* (*Porthetria*) *dispar*, L. (pp. 26–31), O. B. Cooke and Friend report that an extensive survey showed that there was some defoliation due to it, but not enough to cause alarm. Infested areas were sprayed with insecticides, mainly DDT solution applied from a helicopter in May and June. It was concluded that a dosage of 1 lb. DDT per acre will practically eliminate the moth from an area and that 8 oz. gives excellent control. The helicopter appeared to be less useful for applying the spray than an aeroplane. The effect of such a spray on wildlife is discussed from experience in other parts of the United States [*cf. R.A.E.*, A **35** 177]; C. T. Brues in Massachusetts found that other insects were more numerous in areas in which *L. dispar* had been controlled by DDT sprays and the foliage was normal than in unsprayed areas where defoliation was almost complete. Zappe reports on the spread of the Dutch elm disease in Connecticut (pp. 32–33), and J. C. Schread, P. P. Wallace and G. A. Zentmyer on the disease in south-western Connecticut (pp. 33–34). It continued to spread and was found in 16 further places east of the Connecticut river in 1945. The presence of large populations of *Scolytus multistriatus*, Marsh., the principal vector of *C. ulmi*, may account for the abnormally rapid increase of the disease in some places. The beetle appears to be spreading eastwards [*cf.* **35** 356], followed closely by the disease.

Investigations carried out by Zappe, N. Turner, G. H. Plumb, P. Garman and Schread on spraying from a helicopter are described (pp. 37–47). A spray of 1 lb. DDT, 1 U.S. quart xylene and enough kerosene to make 1 U.S. gal. was applied at a rate of 1 U.S. gal. per acre on most plots, and gave a good deposit, even in woodland with a dense canopy of foliage. This dosage apparently gave about 80 per cent. control of *Paleacrita* (*Alsophila*) *vernata*, Peck, on apple and forest trees, but had no effect on adults or newly hatched larvae of the European pine shoot moth [*Rhyacionia buoliana*, Schiff.] on red pine [*Pinus resinosa*], and 3 U.S. gals. per acre was quite ineffective against *Magicicada septendecim*. Spraying a block of *P. resinosa* heavily infested with larvae of *Gilpinia* (*Diprion*) *frutetorum*, F., and *Lambdina athasaria* var. *pellucidaria*, G. & R., with 1 lb. DDT per acre in June apparently reduced defoliation considerably, but two applications were not satisfactory against *Rhagoletis pomonella*, Walsh, on apple and one on oaks at the end of August did not control *Anisota senatoria*, S. & A. On potato, applications on 3rd–4th July, 11th–12th July and in August gave good control of *Epitrix cucumeris*, Harr., and leafhoppers [*Empoasca fabae*, Harr.] on most farms and apparently afforded some control of Aphids. There was no indication that the treatment

reduced the populations of Coccinellid larvae and adults of Braconids. An application of DDT on 13th August to woodland heavily infested with *Popillia japonica*, Newm., caused many beetles to fall to the ground when they came in contact with the sprayed foliage over the following few days, but many recovered, and mortality during the first few hours was estimated at only 10 per cent. The trees remained relatively free from beetles for about four days, but large numbers were present a fortnight after treatment.

S. F. Potts and Friend (pp. 47–60) describe the construction of two blower-atomisers and investigations on their use for applying concentrated sprays [*cf.* **36** 36]. The insecticide most frequently used was a solution of 1 lb. DDT in 1 U.S. quart xylene with 3 U.S. quarts kerosene or horticultural base oil (approximately 12 per cent. DDT), which was sometimes diluted with an equal volume of kerosene. DDT was also dissolved in kerosene or fuel oil at 0·5 lb. per U.S. gal., and pyrethrum extract, rotenone (derris or cubé), nicotine sulphate, nicotine alkaloid, benzene hexachloride and lead arsenate were also applied in water or oil. Some of the mixtures, particularly the DDT solutions, would scorch foliage if applied in large quantities, but proved safe in the small amounts applied by the blower. The importance of particle size and the factors affecting it are discussed. An average dose of 0·43 lb. DDT per acre gave almost complete control of *Lymantria dispar*, and 2 oz. per tree on the larger trees (85 ft. high) was effective against *L. dispar*, *Malacosoma americana*, F., *M. disstria*, Hb., *Anisota senatoria*, *A. rubicunda*, F., *Hyphantria cunea*, Dru., *P. japonica* and species of *Lachnosterna* (*Phyllophaga*). A spray of 16 oz. nicotine alkaloid (99 per cent.) per U.S. gal. kerosene, applied at 4–8 oz. per tree, gave 90–96 per cent. control of adults of the pear psylla [*Psylla pyricola*, Först.] on pear.

Schread (pp. 60–64) gives details of the occurrence of adults of *Popillia japonica* and the intensity of feeding in Connecticut in 1945. In some districts, the drought made the turf unattractive for oviposition and the ground unsuitable for larval development, whereas in others there was sufficient rainfall to keep conditions suitable for them. He also describes the progress of milky disease, caused by *Bacillus popilliae*, in plots infected 4–7 years previously (pp. 64–65). The average percentage of larvae infected in all experimental plots in the State increased steadily from 3·1 in 1940 to 46·5 in 1944 and was 41·5 in 1945, indicating that control has progressed in these plots, and is likely to be considerable where the bacterium has been established for a number of years. R. L. Beard (pp. 66–71) describes a new method of applying spores of *B. popilliae* to the soil. This involves processing the spores in a soluble carrier, so that soil moisture, dew or rain will release them into the soil rapidly, and making the product into tablets such that one will serve for each spot treatment (200 million spores) ; they may be either dropped on the ground or dissolved in water for even more prompt introduction into the soil. Infected larvae of *P. japonica* are ground, and the product is washed through several coarse filters. The filtrate is centrifuged or allowed to settle, and the supernatant fluid decanted. The remaining paste of spores is added to a small quantity of a mixture of dextrose and sodium bicarbonate (2 : 3) and dried, after which the spore content is determined and more carrier added to produce the requisite dilution. The mixture is granulated by moistening, sifting and drying it without heat, and then pressed into tablets. These normally disappear within 2–3 days on the ground, even when no rain falls, and tests showed that the potency of the spores is about the same in the tablets as in dust preparations. The latter, being insoluble, usually remain on the surface of the ground for long periods and are thus slow in action. J. P. Johnson (pp. 71–74) describes laboratory experiments carried out in 1941–42 to determine the effect of temperature on the control of third-instar larvae of *P. japonica* in soil treated with lead arsenate. The larvae were kept at constant temperatures of 57, 67, 77 and 87°F.

in soil treated with lead arsenate at various rates, and statistical analysis of the results showed that the logarithm of the lethal concentration of lead arsenate varied inversely with the logarithm of exposure time at the temperatures tested, and that for any given period of exposure the concentration of lead arsenate required to kill 75 per cent. of the larvae was four times as much at 57° and twice as much at 67° as at 77°, whereas there was little difference between 77 and 87°. The same author (p. 66) describes the effect on different varieties of greenhouse bench roses of applying 3 per cent. DDT in talc to the surface of the soil and watering it in. The amount of actual DDT applied per acre varied from 10 to 87·2 lb. for the plants of different varieties and ages, and all these grew and flowered normally.

In an account of experimental control of orchard pests (pp. 75–82) Garman reports that, in continued tests with reduced schedules [*cf.* **34** 219–221, 308], sprays containing 6 lb. lead arsenate, 1½ lb. Fermate [ferric dimethyl dithiocarbamate] and either 2 lb. bentonite or 5 lb. Veegum (aluminium magnesium silicate gel) per 100 U.S. gals., applied three or four times between the middle of April and late May or early June, gave promising results on three varieties of apple, but were less satisfactory on three others. Increasing the amount of fungicide to 3 lb. increased the protection from scab [*Venturia inaequalis*], but increasing the lead arsenate to 9 lb. reduced the effectiveness of the mixtures. However, with the best treatments, 73 per cent. of the trees yielded 85 per cent. or more unblemished fruit. Control of *Rhagoletis pomonella* was satisfactory only if an additional dust was applied against it in late July. Experiments on peaches showed the desirability of using basic lead arsenate with wettable sulphur in early sprays against *Conotrachelus nenuphar*, Hbst. The combination of early applications of arsenate and late ones of DDT dust against *Cydia* (*Grapholitha*) *molesta*, Busck, resulted in a particularly large amount of undamaged fruit. On quince, applications in June, July and August of a spray of 6 lb. DDT (25 per cent.), 1½ lb. Fermate, ½ lb. skim milk powder and ½ U.S. gal. white mineral oil per 100 U.S. gals. gave good control of the quince curculio [*Conotrachelus crataegi*, Walsh], *Cydia molesta*, and fruit spot diseases, which was not improved when lead arsenate was incorporated in the sprays. A spray of 1 lb. DDT per 100 U.S. gals. as an emulsified solution gave satisfactory insect control, but did not affect the fruit spot.

J. F. Townsend reports (pp. 82–83) that unusual weather in 1945 greatly prolonged the period of emergence of adults of the overwintered generation of *Cydia* (*Carpocapsa*) *pomonella*, L., and low temperatures delayed oviposition until late June and July, so that a large proportion of the first-generation larvae hatched later than was expected. Most damage occurred after the beginning of July, when insecticide coverage had become much reduced in most orchards, and was more severe than usual. Late hatching of an important proportion of the first generation has probably been much more frequent than has been generally realised, since it would escape notice in the former periods of low populations. Examination of past temperature records suggested that hatching of at least one-third of the first generation might have occurred as late as July in 13 of the preceding 27 years, and that more attention to insecticide coverage throughout June and July will be necessary if the moth continues to cause substantial damage. Several additional factors may have had an important bearing on the problem. A tendency towards an increase of the insect is to be expected as a result of summer temperatures above the normal for 15 years, the overgrown condition of many orchards after several years of labour shortage has greatly increased the difficulty of thorough insecticide applications, and the purchase of infested apple boxes from New York has increased the moth population in some orchards. Satisfactory control with lead arsenate was obtained as usual in many orchards.

In an account of experiments on commercial nursery control of the peach tree borer [*Aegeria exitiosa*, Say], P. P. Wallace (pp. 83–89) describes the bionomics of this moth, which sometimes destroys up to 50–60 per cent. of budded peach-tree stock in its second year. It has one generation a year, and the adults emerge throughout the summer from late June or early July. Oviposition has passed its peak by the third week in July, but continues until the frosts. The eggs are usually deposited on the surface of the stems and leaves, and the newly hatched larvae travel down the stem and bore through the bark not more than 1–2 inches below or above ground level. It is considered that a reasonable combination of sanitation and chemical control would eliminate commercial loss. The stumps of discarded seedlings and plum, wild cherry and other species of *Prunus* should be eradicated, and plantings should be isolated and rotated as much as possible. The larvae can be controlled by contact poisons when they are newly-hatched or by soil fumigants when they are in the base of the trees in autumn. In spray tests against the newly hatched larvae, a solution of technical DDT in Velsicol AR 50 (mono- and dimethylnaphthalenes) was emulsified with Emulphor E.L. (a condensation product of ethylene oxide and an organic acid) and applied at various dilutions with and without bentonite to the trunks and lower branches from both sides of the rows on 23rd June. The trees were 14 months old and had been budded during the preceding August. Sprays containing 3 lb. DDT alone or with 3 lb. bentonite or 1½ lb. DDT and 1½ lb. bentonite per 100 U.S. gals. gave complete control, but those containing 1½ lb. DDT without bentonite and 12 oz. DDT with or without 12 oz. bentonite were less effective. One U.S. gal. spray thoroughly covered the trunks of 60 trees, and no leaf injury was observed in favourable weather, but the same spray applied when the temperature was 90°F. and a very dry brisk wind blew droplets on to many of the leaves injured the foliage. The addition of a proprietary alkylaryl sulphonate as a wetting agent, at the rate of 2·5 per cent. of the DDT solvent by weight, greatly improved the wetting properties of the spray and did not cause foaming or appreciably increase the run-off. Emulsions of ethylene-dichloride and Parascalecide, a proprietary emulsion concentrate of paradichlorbenzene [in miscible oil], were tested on two-year-old trees as soil fumigants. The liquids were directed at the soil about two inches from the row, when the air and soil temperatures were 72 and 64°F., respectively. There had been 1½ ins. rain with a high wind two days before, and there was a hollow in the soil at the base of each tree. In most cases the liquid hit the tree base, filled the hollow and was only slowly absorbed into the wet soil. Parascalecide was used at concentrations of 1 : 7 and 1 : 15 and ethylene dichloride at 7·5 and 15 per cent., and 2 and 4 oz. of each diluted emulsion and 8 oz. of the higher concentration of Parascalecide were applied per tree. The results showed that mounding the trees after treatment did not improve the kill of larvae, but reduced insecticide injury to the trees considerably, probably owing to more rapid absorption of the liquid, and it would not ordinarily be necessary. Ethylene dichloride caused severe injury at all doses when the trees were not mounded, but paradichlorbenzene injury was negligible. The percentages of larvae killed ranged from 50 to 100 for both fumigants, and were not related to the dosages, ethylene dichloride giving complete mortality in one test when applied at 2 or 4 oz. 15 per cent. emulsion, and Parascalecide when applied at 2 oz. 1 : 7 emulsion, or, in one test, 4 oz. 1 : 15 emulsion. When one-year-old, uninfested trees received similar treatments, ethylene dichloride caused much more severe injury, but Parascalecide only minor injury at the higher dosages.

In an account of work on the control of *Pseudococcus comstocki*, Kuw., on yews (*Taxus* spp.), Wallace (pp. 90–92) reports that two serious infestations, causing loss of foliage and stunting, were observed in nurseries in the autumn of 1944. The eggs overwinter in the axils of the twigs and leaves, particularly

towards the inside of the plant, and hatch in spring after about two weeks of warm weather, shortly after new growth has begun. The young mealybugs feed for a time at the base of the old needles and on one- and two-year-old twigs, and then migrate over the whole plant. There are 2–3 overlapping generations a year. In tests of sprays, DDT as a suspension or emulsified solution at concentrations of 0·5, 1 and 2 per cent. was ineffective and destroyed parasites of the mealybug, which had been abundant. Nicotine sulphate, Lethane 440 [18·75 per cent. butyl carbitol thiocyanate], kerosene emulsion and liquid lime-sulphur gave incomplete kill at concentrations of 1 : 200, 1 : 300, 3 : 100 and 1 : 39, respectively, but kerosene emulsion at 6 : 100 and lime-sulphur at 1 : 19, 1 : 13·3 and 1 : 9 gave complete kill. A proprietary alkylaryl sulphonate was added as a wetting agent to the DDT and lime-sulphur sprays at the rate of 4 oz. per 100 U.S. gals., and soap to the nicotine sulphate at 6 lb. per 100 U.S. gals. Kerosene emulsion can seldom be used on *Taxus* because of the danger of foliage injury. When lime-sulphur (1 : 9) was applied to heavily infested large potted yews in the greenhouse, the new growth was killed and older foliage slightly injured, and the plants failed to recover properly during the season, even though the mealybugs were completely eliminated. Plants sprayed with lime-sulphur at 1 : 19 showed slight injury to the new growth but recovered quickly. As lime-sulphur leaves a deposit on the leaves for about two months, plants to be sold in spring should be treated in autumn. Foliage injury could probably be avoided by treating the plants when they are dormant and when the temperature will not fall below 32°F. for 24 hours. It is concluded that late autumn applications at 1 : 19 will generally be the most satisfactory treatment.

Turner (pp. 92–94) records laboratory tests in which DDT dusts were mixed with beans infested by the bean "weevil" [*Bruchus obtectus*, Say] in jars; 62·5 mg. 4 per cent. DDT per 100 gm. seed killed all the adults within three days, and 125 mg. 0·5 per cent. DDT per 100 gm. killed them all within four days. In the beans removed from the jars, 500, 250, 125 and 62·5 mg. 0·5 per cent. DDT per 100 gm. seed gave 93·3, 92, 80 and 57·3 per cent. mortality in three days. A further test in which 1, 2 and 4 per cent. DDT dusts were applied to bean seed at various rates and adult Bruchids added indicated that the concentration of the dust made little difference to the effectiveness of a given amount of DDT. The same author (pp. 95–96) describes tests of seed treatments against the seed corn maggot [*Hylemyia cilicrura*, Rond.] in which lima beans were treated with 0·125–1 gm. Spergon [tetrachlorparabenzoquinone], 3 per cent. DDT powder or a mixture of the two, per 100 gm., and planted. There was no marked reduction in infestation after any of the treatments, and the largest number of normal plants was produced by treatment with Spergon alone. DDT apparently affected Spergon, as germination and the proportion of normal plants were lower when it was added.

D. E. Greenwood (pp. 96–98) gives an account of further investgations on the control of wireworms that attack potatoes [*cf.* **35** 358]. Field applications of 600 U.S. gals. of an emulsion of 400 lb. crude D-D mixture (dichlorpropane and dichlorpropene) per acre in May were ineffective, even though wireworms were actively feeding on rye roots at a depth of one inch. The mixture showed no toxicity and failed to prevent feeding. The early part of 1945 was unusually wet, and it is considered that D-D mixture is more effective in dry soils than in wet ones. The results of field tests in which 3 per cent. DDT dust was applied to the soil surface against adults of the eastern field wireworm [*Limonius agonus*, Say] during the flight period [*cf. loc. cit.*] showed that 50 lb. 3 per cent. dust per acre would give effective control under ideal conditions, but that 100–200 lb. per acre would be necessary if the flight period lasted 3–4 weeks or if more than occasional showers occurred. Tests in which the larvae were brought in contact with sprayed surfaces showing a heavy deposit of DDT

gave inconsistent results. All treatments produced low mortality, and the most pronounced effect, which was the inhibition of feeding, soon wore off. When larvae were put in pots with sprayed pieces of potato, most of the mortality was attributable to cannibalism, which may have been due to pronounced hypersensitivity induced by contact with DDT; this hypersensitivity was not observed in other contact treatments. The most successful method of using DDT against wireworms was in baits prepared by adding 0·25–0·5 gm. 3 per cent. DDT dust to ground wheat cereal and moistening the mixture with water, which proved attractive in the absence of other food. Beard (pp. 98–99) records observations on the feeding habits of wireworms [*cf. loc. cit.*]. Wireworms kept at temperatures of 75 or 85°F. with potatoes or sprouting wheat showed a random feeding pattern affected by neither temperature nor food. There was a tendency to fast before a moult and a slight tendency to feed soon after a moult, but these were not consistent enough to explain much of the mass feeding pattern observed in the field. When wireworms were kept for about three months in soil containing different quantities and kinds of food, only those provided with wheat grains increased in weight. There was a progressive decrease in weight among those in ignited soil (containing no organic matter) and some loss among those in untreated soil and soil fortified with leaf mould. It appears that wireworms require growing plants for food if they are to gain in weight, and it is doubtful if organic matter in the soil is utilised to any appreciable extent in maintaining metabolism. No relation between feeding activity and moulting or mortality could be observed; even individuals kept without organic matter moulted as freely as the others, and mortality was sometimes highest among wireworms provided with sprouting wheat and lowest among those in ignited soil.

In a section dealing with miscellaneous insects (pp. 114–115), Zappe records that *Corythucha ulmi*, Osb. & Drake, was very abundant on elms in Litchfield County, causing most of the leaves to turn brown by the middle of August, and that various complaints were received of injury to buildings by *Reticulitermes flavipes*, Koll.

Service and Regulatory Announcements, April–June 1948.—*S.R.A., B.E.P.Q.* no. 172 pp. 21–71. [Washington, D.C.] U.S. Dep. Agric., 1949.

Announcements relating to Quarantine No. 52 against the pink bollworm, *Platyedra* (*Pectinophora*) *gossypiella*, Saund., in the United States [*cf. R.A.E.*, A **33** 286] contains a revision of the quarantine to include Oklahoma (where eight counties are placed under regulation), in addition to Arizona, New Mexico and Texas, and increase the regulated areas in Texas and New Mexico. They also contain administrative instructions (B.E.P.Q. 558, revised) authorising alternative methods of treating cottonseed originating in infested areas for interstate movement. In addition to those already noticed [**36** 105], seed from lightly infested areas and seed from heavily infested areas that has been subjected to heat treatment during ginning and subsequently protected from infestation [**33** 286] may be fumigated in bulk with methyl bromide for 24 hours, under supervision, in an approved gas-tight, cylindrical fumigation chamber with sheet steel walls and top, concrete foundation and base, and a false floor situated at least 12 ins. above the base and perforated by holes $\frac{1}{4}$ in. in diameter and 4 ins. apart in each direction. The floor joists are to be staggered, to permit free circulation of air beneath the floor, and there is to be a circulatory system that can draw air from beneath the false floor and return it to the top of the chamber above the load line. The blower intake is to be connected to the two lateral ducts, one across the centre of each half of the bottom of the chamber and each with four or five equidistant openings adjusted to take in approximately equal quantities of air. The blower must be able to

establish air circulation through a full load of cottonseed within ten minutes ; in experiments, one with a rating of about 6,000–8,000 cu. ft. per minute at a static pressure of 10 ins. and a blade wheel 40 ins. in diameter making 1,800 revolutions per minute established circulation through seed 40 ft. deep in a chamber with a capacity of 54,580 cu. ft. in eight minutes. The return duct is to be so arranged that it can discharge the fumigant into the open air after exposure. A screw conveyer protected by an inverted V-shaped tunnel may be fitted beneath the floor for the removal of the cottonseed ; all entrances to the fumigation chamber, except the exit conveyer channel, are to be fitted with covers that can provide a gas-tight closure. The methyl bromide is to be introduced as a spray into the return duct at a point beyond the blower, and is to be used at a rate of 4 lb. per 1,000 cu. ft. space at average seed temperatures of 60°F. or above and 5 lb. per 1,000 cu. ft. at lower average temperatures. The circulatory system is to be operated before exposure for a period to be designated by the inspector in charge.

Announcements relating to quarantine No. 72 against white-fringed beetles (*Graphognathus* spp.) extend the quarantined area to include parts of two counties in South Carolina, where infestations were found in 1947 [*cf.* **36** 184], and further areas in Alabama, Florida, Georgia and Mississippi.

Wilson (J. D.) & Sleesman (J. P.). **Some of the newer Pesticides damage Plants.**—*Fm Home Res.* **32** no. 245 pp. 58–63, 2 figs., 3 refs. Wooster, Ohio, 1947.

Several of the recently developed insecticides and fungicides are injurious to plants, and the effect of some proprietary preparations on potato, cucumber and tomato was accordingly tested during the winter of 1945–46 using greenhouse plants, which are more susceptible to such damage than outdoor ones. Of 15 proprietary insecticides applied in sprays to cucumbers, nearly all caused some stunting, but whereas four of plant origin caused little or no injury, plants sprayed with DDT, methoxy-DDT, benzene hexachloride and DDD (Rhothane) were severely stunted and in some cases killed ; wettable DDT was less injurious than emulsified solutions. Preparations of cryolite were intermediate in their effects. In other experiments on cucumber, DDT was found to be more harmful in sprays than in dusts and to some varieties of cucumber than to others ; the injury also varied with the diluent and from one proprietary preparation to another, but sprays containing as little as 4 oz. 50 per cent. DDT per 100 U.S. gals. water caused some injury. Wettable DDT injured tomato, especially at a higher concentration, but caused little damage to potato ; emulsified solutions of DDT were injurious to both. Benzene-hexachloride sprays caused stunting and chlorosis in potato and the development of a type of leaf-injury on tomato that resembled shoe-string mosaic.

Observations on the test plants showed that in general the insecticides depressed the rate of transpiration and since this depression was greatest in the case of the most injurious, they probably damaged the leaves enough to cause some of the stomata to cease functioning. The decrease in transpiration became progressively greater on each succeeding day after treatment. It is concluded that the lack of correlation frequently noted between pest control and final yields can be attributed to the counterbalancing effects of chemical damage to the plant.

Smith (E. H.) & Pearce (G. W.). **The Mode of Action of Petroleum Oils as Ovicides.**—*J. econ. Ent.* **41** no. 2 pp. 173–180, 6 figs., 14 refs. Menasha, Wis., 1948.

The following is substantially the authors' summary. It was found that the respiratory rate of eggs of *Cydia* (*Grapholitha*) *molesta*, Busck, was relatively

constant during the first two-thirds of the incubation period and rose sharply during the final period. The effect on the respiratory rate of oil (applied as a 2 per cent. emulsion) was an immediate marked reduction in respiration with a relatively quick recovery to a rate still below normal, and the rate of mortality, deposit of the oil and degree of reduction of respiratory rate were directly related. Treatment of eggs at various stages of development showed a progressive decrease in susceptibility in the oldest eggs, coinciding with the higher respiratory rate during the final period of development. Removing the oil from the eggs at intervals after treatment indicated a rather precise relation between the duration of contact between the eggs and oil and the hatch that followed. Indications were obtained in the course of the work that the eggs produce a toxic gaseous metabolic product other than carbon dioxide during development. It is suggested that the ovicidal action of oil may be due to the prevention of ready elimination of toxic metabolites, causing their accumulation in lethal amounts within the egg.

Brann jr. (J. L.), Avens (A. W.) & Dean (R. W.). **The Application of dormant Oils as Mists.**—*J. econ. Ent.* **41** no. 2 pp. 180–185, 2 figs., 3 refs. Menasha, Wis., 1948.

Conditions often render it difficult to apply a dormant or delayed-dormant oil spray to apple in New York by conventional machinery, but it might be easier to do so by means of mist treatment. The commercial names given to this technique, such as vapo-dusting, vapour spraying, liquid dusting, misting or fogging, are almost synonymous, since all these methods employ machines in which highly concentrated suspensions or solutions of insecticides are broken up into fine particles, diluted with air and carried to the trees in an air stream. Tests of the efficiency of the method were carried out on apple in the Hudson Valley in 1946 and 1947. The machine used consisted of a duster expelling air at about 200 miles per hour through a 4-in. outlet, in the centre and about 1 in. in front of which was fixed a nozzle discharging the spray at an angle of 180° to the air blast. A special nozzle permitting the rate of liquid discharge to be altered was used in 1947. The spray used was a relatively quick-breaking emulsion of oil in water, prepared from a single dormant-type paraffinic oil, and it was applied in the green-tip or delayed-dormant stage to both sides of each row as the equipment moved through the orchard at a speed of about two miles per hour ; the nozzle was kept at least 5 ft. from the nearest branches and the spray directed by hand to give as complete coverage of the trees as possible.

When oil was applied at concentrations of 3·12, 6·25, 12·5 and 25 per cent., the deposit obtained was in proportion to the amount of actual oil used, and the 25 per cent. concentration was the most effective. Increasing the concentration to 50 per cent. made the emulsion so viscous that it had to be applied through a larger nozzle, and the mist failed to break up into particles fine enough to give an even distribution on the bark. The use of undiluted oil resulted in a dangerously high deposit on the branches nearest to the nozzle. The oil deposit on ten samples from the tree tops was at least 70 per cent. of that on twigs at shoulder height, which is about the same as that obtained with conventional sprayers. Comparison with the latter showed that the amount of oil per tree necessary to obtain a given deposit on the bark was about half as much for the mist application. In both years, there was a close correlation between the deposit and the degree of control of overwintering eggs of *Paratetranychus pilosus*, C. & F. In one case in which there were large numbers of eggs on the rough bark of the tree trunks, it was more difficult to obtain an efficient oil deposit on them with mist sprays than with the conventional spray,

but when oil deposits were comparable, control was similar whether the material was applied with a high pressure sprayer or in the form of a mist, and excellent control of overwintering eggs was obtained in other parts of the trees.

Wheeler (E. H.) & Oberle (G. D.). **Oils in dormant Sprays to control European Fruit Lecanium and Cottony Peach Scale.**—*J. econ. Ent.* **41** no. 2 pp. 186–189, 7 refs. Menasha, Wis., 1948.

Dormant sprays containing oils of paraffinic, naphthenic and intermediate types emulsified with blood albumen were tested at 0·25–2 per cent. oil against heavy infestations of *Eulecanium* (*Lecanium*) *corni*, Bch., on quince and at 0·5–3 per cent. against *Pulvinaria amygdali*, Ckll., on peach in New York in 1946. It was shown that the effectiveness of the sprays against both species increased with the paraffinicity of the oil [*cf. R.A.E.*, A **31** 13; **33** 58], although overwintering forms of *P. amygdali* were less susceptible than *E. corni* to dormant oil sprays of any kind. The paraffinic oil gave good control of *E. corni* at 2 per cent. and of *P. amygdali* at 3 per cent. In one series of treatments against *P. amygdali*, in which 2 lb. dinitro powder (40 per cent. dinitro-o-cresol) was combined with 100 U.S. gals. 1, 2 and 4 per cent. intermediate-type oil, the effectiveness of the spray was greatly increased, but twigs treated with it showed marked increases in the rate of respiration, followed by decreases to below normal due to the injuring or killing of buds. Emulsification with Bordeaux mixture (5 : 5 : 100) greatly reduced the effectiveness of 2 and 4 per cent. intermediate oil against *P. amygdali*; this combination caused changes in respiratory rates and retarded the development of the buds, but no permanent injury resulted. The three oil emulsions alone at concentrations of up to 4 per cent. oil caused no consistent respiratory changes in peach twigs and no harmful effect attributable to the oils except a slight retardation in development associated with the heavier concentrations.

Chapman (P. J.) & Avens (A. W.). **The Toxicology of 4,6 Dinitro-o-cresol as an Aphid Ovicide.**—*J. econ. Ent.* **41** no. 2 pp. 190–198, 6 figs., 15 refs. Menasha, Wis., 1948.

The following is based on the authors' summary. Laboratory studies made under controlled conditions in New York on the toxicity of 4,6-dinitro-o-cresol [numbered with OH as 1] in aqueous solutions of the acid or salts of it to the eggs of 22 species of Aphids in 1944–47 revealed a difference in susceptibility such that the minimum effective concentration (that giving 95 per cent. kill) varied from as little as 0·003 per cent. for some species to 0·05 per cent. or more for others. A minimum effective concentration of 0·012 per cent. was indicated for the eggs of *Aphis pomi*, Deg., on apple twigs.

A correlation was found for various Aphid species between susceptibility to dinitro-o-cresol and the relative time of hatching. Eggs of species that hatch early were the most readily killed, and increasingly more toxicant was required as the date of hatching was later. Little if any difference in susceptibility was detected in Aphid eggs at various stages of embryonic development, and solutions of the acid and of its sodium, calcium, ammonium and magnesium salts were found to be equally effective at the same concentration of dinitro-o-cresol [*cf. R.A.E.*, A **36** 111].

Hofmaster (R. N.) & Anderson (L. D.). **Potato Tuberworm Control in Virginia.**—*J. econ. Ent.* **41** no. 2 pp. 198–201, 5 refs. Menasha, Wis., 1948.

Gnorimoschema operculella, Zell., was first reported on field potatoes in Tidewater, Virginia, in 1923, and since then has increased to outbreak numbers

and has caused considerable damage to potatoes in field and storage, especially during dry seasons. In view of the need for better control measures against it, tests with DDT, DDD (dichlordiphenyldichlorethane) and BHC (benzene hexachloride) were made in 1947.

The following is mainly based on the authors' summary. Complete mortality of moths and protection from infestation was obtained when potatoes were stored in burlap bags dipped in solutions of 1–5 per cent. DDT in xylene and the bags were exposed to adults or pupae ; they were still effective 6½ months after dipping. Keeping potatoes with confetti or paper streamers treated with 5 per cent. DDT killed most of the moths and greatly reduced infestation by larvae ; all larvae that came in contact with the confetti died.

In field tests, excellent control of the larvae in the foliage was obtained by two applications on 9th and 19th September of dusts impregnated with 1, 2 and 3 per cent. DDT, 2 per cent. regular DDT dust, 5 per cent. DDD dust and a dust containing 1 per cent. γBHC. These dusts reduced populations by at least 99 per cent. in all the treated areas and resulted in a decrease of 97–98 per cent. in the number of leaflets with tunnels. Single applications on 11th September of sprays containing 1 lb. DDT, 1 lb. DDD or 0·15 lb.γ BHC per 100 U.S. gals. as wettable powders or 1 U.S. quart 25 per cent. DDT emulsion concentrate per 100 U.S. gals. caused highly significant reductions in infested foliage for 12 days, with no difference between them, but the BHC spray was significantly less effective than the others after 27 days, when the percentage reduction in leaflets with tunnels was 64 for BHC and at least 94 for DDT and DDD.

HUCKETT (H. C.). **Control of the Two-spotted Spider Mite on Lima Beans, on Long Island.**—*J. econ. Ent.* **41** no. 2 pp. 202–206, 7 refs. Menasha, Wis., 1948.

The results are given of tests in 1947 with several synthetic organic compounds for the control of *Tetranychus bimaculatus*, Harvey, on lima beans on Long Island, New York. The sprays and dusts were applied four times between 2nd July and 12th August on beans sown on 2nd June and harvested between 29th August and 6th September, and all plots were treated with a dust of cubé in talc (0·75 per cent. rotenone) on 20th June and 5th August against the Mexican bean beetle [*Epilachna varivestis*, Muls.].

It soon became apparent that the foliage in plots dusted with parathion or toxaphene (chlorinated camphene) or sprayed with hexaethyl tetraphosphate or toxaphene was noticeably freer from mite injury than that in plots treated with sulphur or the other dusts tested. For the dusts, the percentage increases over no treatment in the yield of marketable pods that were considered commercially free of discoloration due to the feeding of the mite were 44·3 and 33·4 for 1 and 0·5 per cent. parathion, which also resulted in little infestation by the bean aphid [*Aphis fabae*, Scop.] or *E. varivestis*, 40 and 38·9 for 10 and 5 per cent. azobenzene, which was less effective against the two insects, 24 and 22·2 for 5 and 3 per cent. toxaphene and 23·7 and 21·5 for 3 and 2 per cent. chlordan, all of which gave some control of the Aphid but little of *E. varivestis*, and 18·2 and 16·8 for 1 per cent. dinitro-o-cyclohexylphenol and 1·7 per cent. of the dicyclohexylamine salt of this compound, which gave no significant control of the insects ; mixtures containing 50 per cent. sulphur, with or without 1 per cent. dinitrocyclohexylphenol gave little protection against the mite and reduced the yield. The comparable increases for the sprays, the amounts of ingredients being given per 100 U.S. gals., were 30·8, 32·4 and 28·8 for 1 U.S. pint hexaethyl tetraphosphate, 1 U.S. quart of a 50 per cent. concentrate of toxaphene and 4 lb. 25 per cent. wettable toxaphene, all of which gave maximum control of the Aphid and beetle, 25·3 for 8 oz. hexaethyl tetraphosphate, which

gave good control of the insects, 24·3 and 25·3 for 4 and 2 lb. 48 per cent. wettable azobenzene powder, which permitted appreciable infestation by them, 13·8 and 16 for suspensions of $\frac{1}{2}$ or 1 lb. 25 per cent. γ benzene-hexachloride powder, and 9·9 and 9·2 for 1 and 2 lb. 50 per cent. wettable chlordan ; toxaphene was less effective at lower concentrations, and 12·5 lb. wettable sulphur and 2 lb. 20 per cent. dicyclohexylamine salt of dinitrocyclohexylphenol both reduced the yield. During 1947, there was no significant indication of plant injury due to treatment, such as had occurred in previous tests of dusts containing dinitro and azobenzene compounds.

HOUGH (W. S.). **Control of Mites on Apple Trees sprayed with DDT.**—*J. econ. Ent.* **41** no. 2 pp. 207–209, 2 refs. Menasha, Wis., 1948.

Field tests on the control of mites on apple trees sprayed with DDT against the codling moth [*Cydia pomonella*, L.] in Virginia [*cf. R.A.E.*, A **35** 264] were continued in 1946, when the acaricides were added to wettable DDT in three cover sprays. Of those tested, 4 lb. 25 per cent. wettable azobenzene or 2 U.S. quarts disodium ethylene bisdithiocarbamate (Dithane-14) per 100 U.S. gals. gave no control, and 1 lb. xanthone, 4 lb. 30 per cent. wettable hydroxypentamethylflavan, 6 U.S. quarts 83 per cent. summer oil emulsion and $1\frac{1}{4}$ lb. triethanolamine salt of dinitro-o-cyclohexylphenol were either less effective or no more effective than DN-111 (dicyclohexylamine salt of dinitro-o-cyclohexylphenol), the standard acaricide used by growers.

In 1947, when about 94 per cent. of the mites were European red mites [*Paratetranychus pilosus*, C. & F.] and the rest mainly *Tetranychus schoenei*, McG., and the materials were added to three DDT cover sprays in June–July or tested without DDT twice in July or once in August, 40 per cent. di(4-chlorphenoxy) methane at $1\frac{1}{4}$ and $2\frac{1}{2}$ lb. per 100 U.S. gals. ranked among the most effective treatments in all three tests. Other promising materials were 1 U.S. quart dioctyl phthalate and 1 lb. 15 per cent. parathion per 100 U.S. gals., though the latter gave practically no control in one replicate of the second test. N-dodecyl-2-thiazolinyl sulphide (1 : 800) showed promise in the third test, which was the only one in which it was used. In general, tetraethyl pyrophosphate was more effective than hexaethyl tetraphosphate, but both were relatively ineffective at a concentration of 1 : 800. None of the sprays injured fruit or foliage except when hexaethyl tetraphosphate was applied to trees that had been sprayed with Bordeaux mixture about ten days before. In commercial use, hexaethyl tetraphosphate was less effective than DN-111, chiefly owing to its lack of residual effect, and its use was discontinued.

All the materials increased the effectiveness of the DDT sprays against *Cydia* in the field, but while some did so in the laboratory, others reduced it, possibly owing to the wetting agent used. Parathion increased it most in both cases. In tests in which sprayed fruits were exposed to larvae in the laboratory, it afforded more protection than DDT. The deposit was still effective after five days on apples suspended in the open, but lost much of its effect in 14 days in the orchard.

HARMAN (S. W.). **Red-banded Leaf Roller Control in western New York in 1947.**—*J. econ. Ent.* **41** no. 2 pp. 210–212. Menasha, Wis., 1948.

Eulia (*Argyrotaenia*) *velutinana*, Wlk., has usually been of negligible importance on apple in western New York, occasional sporadic outbreaks having been controlled by the lead arsenate in the petal-fall and first cover spray applied against the codling moth [*Cydia pomonella*, L.], but it injured up to 20 per cent. of the fruit in 1946 and caused almost complete loss of crop in some orchards in 1947. In such cases, over 90 per cent. of the apples were injured and 75 per cent. dropped before harvest time, while feeding areas were

evident on almost every leaf. This Tortricid normally has two complete generations a year in western New York and sometimes a partial third. Hatching of the first generation begins several days before that of *C. pomonella* and lasts for about two weeks. In control tests in 1947, in which calyx and ten-day sprays of lead arsenate on 3rd and 12th June were followed by fortnightly cover sprays of 3 lb. lead arsenate or 2 lb. 50 per cent. wettable DDT per 100 U.S. gals., 3–5 cover sprays of lead arsenate and 3–6 of DDT reduced the percentage of apples damaged by *E. velutinana* from 71·8 to 5·8–0·9 and 21·5–12·3, respectively. When the ten-day spray was omitted and three covers of lead arsenate and DDT applied, the percentages were 19·2 and 48·7, respectively. These results suggest that the substitution of DDT for lead arsenate in the apple spray programme may be the cause of the present outbreak [*cf. R.A.E.*, A **36** 323]. In a test in which sprays were applied against the second generation on 7th August and in some cases on 20th August, the percentages of apples damaged were, respectively, 64·3 and 65·6 for one and two applications of 2 lb. 50 per cent. wettable DDT (per 100 U.S. gals.), 66·9 and 24·5 for two of 1 and 2 lb. actual DDT in emulsified solution, 42·3 and 24·5 for one and two of 3 lb. lead arsenate, 49·1 and 16 for one and two of 1 lb. DDT with 3 lb. lead arsenate, 4·5 for two of 3 lb. 15 per cent. wettable parathion powder, and 84·4–91·5 on trees not sprayed in August. Since none of the late applications of DDT or lead arsenate gave satisfactory results, it is concluded that sprays applied against the first generation in June were much more effective in preventing fruit injury than applications made against the second generation in August. Whatever the material used, sprays had to be directed to cover the lower leaf surfaces, where the young larvae were feeding.

GARMAN (P.). **Two Years of Experience with Mist Blowers for Control of Apple Pests.**—*J. econ. Ent.* **41** no. 2 pp. 213–216, 1 fig. Menasha, Wis., 1948.

After two years work with mist blowers [*cf. R.A.E.*, A **37** 372, 378] for the control of apple pests in Connecticut, the author considers that their advantages consist in ease of operation, the small amounts of water or solution carried and the large number of trees sprayed with one filling, the lack of removal of previous sprays, the possibility of making spray and dust applications with one machine and the speed of operation, whereas their disadvantages are the difficulty of operating in moderate winds, the insufficient agitation of concentrates in the outfits used at present, the difficulty of obtaining complete cover of all parts of the tree, sometimes even in calm periods, owing to lack of flexibility in the machines, and the fact that the nozzles used are not completely suited to the application of concentrates. He concludes that although the mist blower cannot yet be recommended in place of the older conventional spraying machines, the method is sound and the main problems are mechanical.

The results obtained in 1946 showed that five mist sprays of 5 lb. dry wettable sulphur, 3 lb. lead arsenate, 1 U.S. pint white mineral oil (omitted in the last application) and enough water to make 4 U.S. gals., applied between 29th April and 15th July, gave almost or quite as good general insect and disease control as 11 or 12 ordinary sprays of 2 or 3 lb. lead arsenate, 3 or 4 lb. wettable sulphur and 2 or 3 lb. lime per 100 U.S. gals. applied between 17th April and 25th July. Five mist sprays of 1½ lb. 75 per cent. Fermate [ferric dimethyl dithiocarbamate], 6 lb. lead arsenate, 6 oz. skim milk powder, 3 U.S. pints white mineral oil (omitted in the last application) and 1 oz. suspending agent with water to make 4 U.S. gals., followed by one dust, applied between 23rd April and 15th July, controlled scab [*Venturia inaequalis*] better than any other schedule. The control of the apple maggot [*Rhagoletis pomonella*, Walsh] was satisfactory in all plots.

In 1947, mist-spray schedules of lead arsenate with Fermate or sulphur gave good control of the curculio [*Conotrachelus nenuphar*, Hbst.] and the Fermate spray was the more effective against scab and (in the one orchard in which it was present) *R. pomonella*. The equipment used in the two years is briefly described.

GRAHAM (C.). **Control of Peach Insects with new and old Insecticides.**—*J. econ. Ent.* **41** no. 2 pp. 217–219. Menasha, Wis., 1948.

In 1946 and 1947, experiments were carried out in Maryland to test the comparative efficiency of BHC (benzene hexachloride) and acid and basic lead arsenates, alone or with DDT, for the control of the plum curculio [*Conotrachelus nenuphar*, Hbst.] and the Hemiptera that cause cat-facing of peaches.

In 1946, under conditions of light infestation by *Conotrachelus* and cat-facing insects, the spray ingredients and (in brackets) the percentages of peaches injured by *Conotrachelus* were 4 lb. basic lead arsenate and 4 lb. lime, alone (4·92) or with 4 oz. DDT (4·11), applied to peach trees once at the petal-fall and once at the shuck-slip stage, 2 lb. acid lead arsenate and 3 lb. zinc sulphate with either 2 lb. lime (1·71) or 4 oz. DDT (2·09), and 3 lb. BHC, alone (2·45) and with 6 oz. DDT (3·22). Acid lead arsenate was injurious to the leaves and twigs and basic lead arsenate rather so, but BHC caused no injury and improved the colour and growth of the trees.

In 1947, 14 spray schedules containing DDT, methoxy-DDT, BHC, hexaethyl tetraphosphate, acid lead arsenate and Ryanex and a methoxy-DDT aerosol were tested, and none controlled the insects causing cat-facing. There was no noticeable difference in control between five applications of sprays from the pre-blossom stage and four from petal fall. The percentage of fruits showing stings, which were attributed to *Euschistus servus*, Say, and *Acrosternum hilare*, Say, was high on all plots except the one treated with acid lead arsenate, on which the thin foliage was probably unattractive to the insects, and one treated four times with the methoxy-DDT aerosol, which was apparently more effective against the Pentatomids than the sprays. The three plots on which DDT was used showed an average of about 10 per cent. less infestation of fruit by the oriental fruit moth [*Cydia molesta*, Busck] than the other plots, and good commercial control of *Conotrachelus* was obtained with all sprays containing BHC. Plots treated with lead arsenate or Ryanex were no better than the controls, which received sulphur sprays only, and lead arsenate was the only material that injured the foliage and twigs. The data for *Cydia molesta* showed that one application on 4th August was more effective than one on 22nd July and that treatment on both dates was still better.

SMITH (C. F.). **Plum Curculio Control in North Carolina.**—*J. econ. Ent.* **41** no. 2 pp. 220–227, 4 figs., 5 refs. Menasha, Wis., 1948.

Damage to peaches by the plum curculio [*Conotrachelus nenuphar*, Hbst.] was especially severe in North Carolina in 1945 and 1946. Many orchards had more than 50 per cent. infested fruit at harvest and a large population of adults entering hibernation in the autumn of 1946. Examination of soil and débris showed that most of the adults hibernate in the débris within 50 ft. of the edges of the woods surrounding the peach orchards. Burning the débris in the winter of 1946–47 gave more than 90 per cent. control of the adults in it, but the relative numbers in the border rows of the orchards in the autumn of 1946 and the spring of 1947 indicated that the treatment was of no value. In 1947, insecticide tests were carried out in orchards in the Sand Hills area. Most of the treated plots received one or two sprays of 4 lb. cryolite per 100 U.S. gals. in early April followed by three or four of 2 lb. acid or 4 lb. basic lead arsenate

with sulphur and safeners or by four or five of 4 lb. BHC (benzene hexachloride) and 6 lb. sulphur per 100 U.S. gals. The population of adults was about the same throughout the summer in all treated plots, but the proportion of dropped fruit that was infested was 2–4 times as great in plots treated with lead arsenate as in those treated with BHC. The percentages of peaches infested at harvest averaged less than 1 for BHC and varied from less than 1 to 6 for lead arsenate. Growers found BHC very effective when the spray was used at 3–4 U.S. gals. per tree, which was enough to drench the tree thoroughly and wet the soil under it, but less so when it was used less heavily. Field observations indicated that it was necessary to wet the soil thoroughly with the spray, as the adults leave the tree by crawling down the trunk soon after spraying, and if the ground is not well covered, they quickly move out of the effective zone of spray material. BHC is effective on the ground as it seems to serve as both contact poison and fumigant for *C. nenuphar*.

In 1946, BHC caused a musty flavour in the fruit when it was used too near harvest ; in 1947, it caused no alteration of flavour in fresh ripe peaches sprayed 4–5 and two days before harvest, but a mild almond flavour in those picked a week after the final spray and canned.

Sprays of 1 quart actual HETP (hexaethyl tetraphosphate) in 4½ gals. water, applied with a fog machine at the rate of about 3 U.S. pints HETP per acre on 25th April, reduced the number of adults jarred from the trees from 16 to 0 per tree in 12 hours. HETP applied as a fog from an aeroplane gave similar results, and tests in which it was applied with a conventional ground machine indicated that approximately 1,500 cc. HETP per acre is required for satisfactory control of *C. nenuphar*, regardless of the way it is applied. It is doubtful whether it will ever be of practical value against the weevil, as it has no residual effect and may injure the foliage. Sprays of 4 lb. 29 per cent. chlorinated camphene [toxaphene] and 2 and 4 lb. 6 per cent. γBHC per 100 U.S. gals. water, applied on 17th April 1947, reduced the average numbers of adults per tree in the border rows from 22, 20 and 18, respectively, to 19, 16 and 3 the following day, 3, 8 and 2 after four days and 1, 6 and 2 after eight days.

No spray injury was observed on trees treated with BHC, but cryolite caused some injury to fruits even when used only at petal-fall. Trees that received five applications of acid or basic lead arsenate were severely defoliated by 3rd October. HETP caused injury to leaves and fruit that was more severe on weak trees, and toxaphene caused scorching of the leaves and leaf-drop within a week when applied without sulphur, but not when applied with it.

Stearns (L. A.) & Warren (J. C.). **Control of Plum Curculio with Benzene Hexachloride.**—*J. econ. Ent.* **41** no. 2 pp. 227–230. Menasha, Wis., 1948.

The results are given of investigations carried out in Delaware in 1947 to compare sprays of lead arsenate and BHC (benzene hexachloride) for the control of *Conotrachelus nenuphar*, Hbst., on peach. The trees received a dormant spray of lime-sulphur, a pre-blossom spray of flotation sulphur, and two sprays on 19th May and 2nd June of 4 lb. basic lead arsenate with 8 lb. spray lime and 10 lb. flotation sulphur, or of 2 lb. acid lead arsenate with 8 lb. spray lime, 10 lb. flotation sulphur and 2 lb. zinc sulphate, or sprays of 3 lb. BHC with 10 lb. flotation sulphur on these two dates and one of 3 lb. BHC on 26th May. All treatments applied on 19th May included an adhesive, and three additional sulphur sprays were applied to all plots to protect the maturing crop from brown rot [*Sclerotinia*]. The numbers of overwintered adults jarred from the trees in late May and June were 245, 505 and 116 on the plots treated with acid and basic lead arsenate and BHC, respectively. Infestation

of small peaches appeared to be directly correlated with adult abundance, 78, 56 and 1 per cent. of all peaches that dropped during June in the basic and acid lead-arsenate and BHC plots, respectively, containing first-generation larvae. Leaf-fall throughout the summer was 36 and 54 per cent. less for BHC than for basic and acid lead arsenate, respectively, and the numbers of twigs injured by the first generation of the oriental fruit moth [*Cydia molesta*, Busck] were 11·1, 4·6 and 3·5 per tree for basic and acid lead arsenate and BHC, though these figures are considered of doubtful significance ; the corresponding crops were 13,911, 17,447 and 21,030 peaches per 12 trees.

Unfavourable weather in 1947 delayed fruit maturity by about ten days, as a result of which there was a heavy pre-harvest drop, opportunity for greater damage by late larvae of *C. molesta* and considerable brown rot infection. Comparison at harvest of the plots treated with BHC and acid lead arsenate showed that the percentage pre-harvest drops were 31 and 19, respectively, the percentages of clean fruits 74 and 88, the losses from *C. molesta* 17 and 7·5 per cent. and the amounts of brown rot infection 9 and 4 per cent. The peaches were somewhat smaller when BHC was used (251 instead of 220 per bushel) but the proportion injured by *Conotrachelus* did not exceed 2 per cent. in either case. It is concluded that the considerable benefit gained from the use of BHC early in the season was more than offset by complications attributable to delayed ripening.

GRAYSON (J. M.). **Benzene Hexachloride and DDT to control Plum Curculio.**—*J. econ. Ent.* **41** no. 2 pp. 231–234, 2 figs., 5 refs. Menasha, Wis., 1948.

The following is based on the author's summary. In an adequately replicated experiment, carried out in a peach orchard in Virginia in 1947, four applications of a spray containing enough BHC (benzene hexachloride) to give concentrations of 0·05, 0·1 and 0·2 lb. γ isomer per 100 U.S. gals. reduced the numbers of larvae of the plum curculio [*Conotrachelus nenuphar*, Hbst.] significantly more than three applications of the standard spray of acid lead arsenate (2 lb. lead arsenate, 3 lb. zinc sulphate and 6 lb. lime per 100 U.S. gals.). Significantly fewer larvae were obtained from peaches from trees sprayed with the highest concentration of BHC than from those receiving the lowest, but the difference between two and four applications of the former was not significant.

From laboratory cage experiments to determine the toxicity of various concentrations of BHC and the standard spray of acid lead arsenate to the adults within different periods of time, it was calculated that 0·32, 0·233 and 0·174 lb. γ BHC per 100 U.S. gals. spray were required to kill 50 per cent. within two, four and eight days, respectively, and 0·779–0·816 lb. per 100 U.S. gals. for 95 per cent. mortality in 4–8 days. Less than 50 per cent. were killed within eight days by the lead arsenate.

In field and laboratory experiments, a wettable DDT dust mixed with the top 2–3 inches of soil at rates of 10 and 25 lb. actual DDT per acre gave almost no control of the larvae, but similar treatments with BHC dust at 0·5 and 1 lb. γ isomer per acre gave 28·1 and 60·9 per cent. control in the field and 38·5 and 58·5 per cent. in the laboratory.

DEWEY (J. E.) & VAN GELUWE (J. D.). **Some organic Insecticides for Control of Plum Curculio on Peaches.**—*J. econ. Ent.* **41** no. 2 pp. 235–239, 2 refs. Menasha, Wis., 1948.

In New York, severe dropping of peaches generally occurs during June and July, and most of the dropped fruits appear to have been injured by the feeding or oviposition of the plum curculio [*Conotrachelus nenuphar*, Hbst.]. One application of lead arsenate for light to moderate infestations and two

for heavy ones has been the standard treatment, but one spray has been observed to give little or no control, and two, though more effective, have nearly always resulted in severe wood cankering from arsenical injury. Dropped peaches are nearly as numerous in sprayed as in unsprayed orchards, and with the increasing use of blossom sprays for thinning, this loss of fruit becomes increasingly important. Investigations were therefore carried out in 1946 and 1947 to compare BHC (benzene hexachloride), chlordan, toxaphene (chlorinated camphene) and parathion with lead arsenate for control of the weevil. The treatments were evaluated on the basis of injury to dropped fruit, amount of dropped fruit, total injury to the crop and injury at harvest, since no one criterion gives a true picture of the damage. Spray quantities are given per 100 U.S. gals.

In 1946, a spray of 3 lb. BHC powder (3·79 per cent. γ isomer), applied on 7th May (petal-fall), 22nd and 26th May (35 and 90 per cent. shuck-off) and 5th June resulted in significantly better control than one or two applications of 2 lb. lead arsenate and 16 lb. hydrated lime or no treatment, and was more effective than the same spray applied only on the first three dates. When single applications of BHC were made on 26th May, sprays containing 3 and 4 lb. 3·79 per cent. γ isomer and 3 lb. 5 per cent. γ isomer were better than those containing 2 lb. of the former. The lead-arsenate treatments gave no significant control, and the trees were less vigorous and of poorer foliage colour than those sprayed with BHC, which caused no injury to leaf buds, tree wood or fruits and did not affect the flavour of the ripe raw fruit, but infection with brown rot [*Sclerotinia*] was heavier on the BHC plots [*cf. R.A.E.*, A **37** 384].

In 1947, the spray dates were 3rd June, when about 95 per cent. of the shucks had fallen, and 9th and 12th June. Sprays of 15 per cent. parathion, applied twice at 1·75 or 4 lb., 6 per cent. γ BHC applied two or three times at 3 lb., 50 per cent. chlordan applied twice at 2 lb., and 25 per cent. toxaphene applied twice at 2 lb. were more effective than one or two applications of 2 lb. lead arsenate with 16 lb. lime, which gave little or no control. No injury to foliage, buds, fruit or any part of the tree resulted from the use of the organic materials. BHC caused no apparent increase in brown rot, and the parathion plots had smaller populations of the European red mite [*Paratetranychus pilosus*, C. & F.] and the two-spotted spider mite [*Tetranychus bimaculatus*, Harvey] than the others in September.

Results in both years showed that injury to the dropped fruit by *Conotrachelus* exceeded 79 per cent., indicating that injury by this weevil is at least a contributing factor to the loss of fruit by dropping. Parathion, BHC and possibly chlordan appeared to be toxic to the newly hatched larvae or eggs as well as to the adults and resulted in significantly less dropped fruit than two applications of lead arsenate, and the yields of fruit should be higher on trees sprayed with these materials than on those treated with lead arsenate or toxaphene. Toxaphene should be tested at higher concentrations.

LaPlante jr. (A. A.) & Wheeler (E. H.). **DDT and Benzene Hexachloride in Sprays to control Peach Tree Borer.**—*J. econ. Ent.* **41** no. 2 pp. 240–244, 1 ref. Menasha, Wis., 1948.

Of the insects injuring peach trees in New York, *Aegeria* (*Sanninoidea*) *exitiosa*, Say, has been one of the more difficult to control. Treatment with paradichlorbenzene and emulsions of ethylene or propylene dichloride have occasionally caused serious injury and failed to control larvae at heights of six inches or more, and when they are not applied until late autumn or spring, the larvae damage the trees for several months before being destroyed. The following is based on the authors' summary of this report of results obtained in laboratory experiments in 1945 and field experiments in 1945–47 with

sprays of DDT to kill the newly hatched larvae [*cf. R.A.E.*, A **37** 374] and of limited tests with BHC (benzene hexachloride) against established larvae in 1947.

The results showed that DDT was effective when sprayed directly on to the trunks, crotches and bases of the branches at concentrations of at least 1 lb. per 100 U.S. gals. Applications should begin as soon as the larvae hatch and be repeated at intervals of three weeks until towards the end of August. Larvae of *A.* (*Synanthedon*) *pictipes*, G. & R., and *A. exitiosa* associated with wounds were not noticeably controlled by these treatments. One application of BHC at a concentration giving 4 oz. γ isomer per 100 U.S. gals. near the end of the hatching period was nearly as effective as two earlier ones of DDT in reducing the numbers of larvae in direct entries on uninjured bark and more effective than the DDT in reducing the numbers in wounds. It is concluded that both these insecticides used as sprays have marked advantages over paradichlorbenzene or the dichlorides.

HAMILTON (D. W.). **Summer Control of Pear Psylla during 1947.**—*J. econ. Ent.* **41** no. 2 pp. 244–248, 1 ref. Menasha, Wis., 1948.

In seasons in which the development of *Psylla pyricola*, Först., is favoured by weather, the dormant sprays in general use on pear in eastern New York cannot be depended on to prevent outbreaks, and supplementary control measures are required in summer. The Psyllid was extremely injurious throughout the area in 1946 and 1947, and further experiments with summer sprays [*cf. R.A.E.*, A **36** 334] were carried out in 1947. The spraying dates were 27th May, 29th July and 3rd September, and all quantities of spray ingredients are per 100 U.S. gals.

The control given by nicotine sulphate was not entirely satisfactory, as the low residual effect permitted rapid increases in population from nymphs that survived the initial treatment, but it was more effective in July, when the air temperature was 84°F., than in May, when it was only 68°F. It was also more effective at a concentration of 16 oz. than at 8 oz., and the addition of 2 lb. 50 per cent. DDT to 16 oz. nicotine sulphate in May did not appear to affect the results materially. The effect of 8 oz. nicotine sulphate was improved by the addition of 1 U.S. gal. summer oil and 8 oz. blood albumen and still more by the addition of 10 lb. hydrated lime. Both supplements increased the knockdown of adults as well as the kill of nymphs, but oil may result in severe injury to fruit and foliage if it is used shortly before or after DDT is applied against the codling moth [*Cydia pomonella*, L.], and the mixture containing lime leaves heavy visible deposits on the fruit and may cause russetting if applied when temperatures are extremely high. A spray in which 1 lb. lime and 2 oz. Triton B-1956 (a phthalic glyceryl alkyd resin) as a wetting agent were added to nicotine sulphate was about as effective against nymphs as those containing summer oil or higher concentrations of lime and knocked down more adults, and it appeared to be less likely to russet fruit, left only a light visible residue and would not interfere with the use of DDT.

A wettable powder containing 15 per cent. parathion, used at 1 lb. on all three dates, killed all the nymphs present and caused no injury to fruit or foliage under widely varying weather conditions. No nymphs were present 9–12 days after application and few 23–27 days after; heavy nymphal populations were found 41 days after spraying, but this might not have occurred if a large block or the entire orchard had been treated. In the September tests, a concentration as low as 8 oz. gave complete kills of nymphs, and very few were present 23 days later. There was little knockdown of adults at the time of spraying, however. Residue determinations showed that parathion weathered rapidly on both leaves and fruit, very little being left after 14 days regardless of spray concentration.

Toxaphene (chlorinated camphene) applied as a 25 per cent. wettable powder and a 50 per cent. emulsifiable solution in May, gave poor control, but in July, the wettable powder used at 4 lb. reduced the nymphal population to a low level for 9 days, and in September, 2, 3 and 4 lb. powder gave good control of nymphs, the population being kept at a low level for 23 days. No injury to fruit or foliage was apparent, but the immediate kill of adults was low. A spray containing 2 lb. ground cubé root (4·8 per cent. rotenone) and 1 U.S. gal. summer oil, used in May and July, reduced nymphal populations to a low level within 48 hours and maintained its effectiveness for at least three weeks, and a commercial paste containing 50 per cent. cubé root gave good control when used with summer oil in May, but was difficult to mix with water. Knockdown of adults was high, largely owing to the oil, and no spray injury was observed.

Technical hexaethyl tetraphosphate at 8 oz. with 2 oz. Triton B-1956 gave high kills of nymphs in May and July, but nymphs that hatched from the eggs present were not affected and the spurs were rapidly reinfested. Knockdown of adults was about the same as with nicotine sulphate, and there was slight injury to fruit and new growth. A spray containing 4 oz. tetraethyl pyrophosphate with 2 oz. of the spreader killed most of the nymphs present at the time of application (May), but reinfestation soon occurred and fruits and new growth were damaged. Commercial products containing 0·8 per cent. pyrethrins with 8 per cent. piperonyl cyclonene or piperonyl butoxide, applied at 1 lb., or 4 per cent. pyrethrins with 40 per cent. of the cyclonene or butoxide, at 8 oz., gave high kills of nymphs and knocked down many adults, but nymphal populations soon increased in all plots and there was a varying amount of plant and fruit injury, possibly due to the solvent used. A commercial emulsion concentrate containing 50 per cent. technical chlordan, used in May at 16 oz., killed only about 50 per cent. of the nymphs and was not tested again, and in a single test in May, a spray containing 2 lb. pyrethrum flowers and 1 U.S. gal. summer oil killed 86 per cent. of the nymphs without injuring the foliage, which is considered promising.

Langford (G. S.) & Vincent (R. H.). **Fogging with DDT for Japanese Beetle Control.**—*J. econ. Ent.* **41** no. 2 pp. 249–251, 2 refs. Menasha, Wis., 1948.

Since a machine releasing a solution of 5 per cent. DDT in fuel oil as a fog with a particle size of 40–60 microns proved rather ineffective against adults of the Japanese beetle [*Popillia japonica*, Newm.] in eight cities and towns in Maryland in 1947, the authors discuss ways of improving the control in the light of tests in the cities and towns, most of which were treated 2–4 times, and in various field situations, and tests of the mortality of beetles in cages at various distances from the machine. It was found that fast-drifting fogs were relatively inefficient and that the best results were obtained under conditions of calm with other meteorological factors that tended to enable the fog to engulf the area under treatment, hang close to the ground and not dissipate rapidly. These conditions occur most frequently in the late evening or early morning in Maryland. Fine or dry fogs with a particle size of 10–20 microns were much less effective than coarse or wet ones (40–60 microns). High concentrations of DDT (with an auxiliary solvent) were needed to ensure 100 per cent. mortality even at short distances from the machine and the swathe width over which a given fog killed beetles depended to a large extent on the concentration of DDT; formulae containing 20 per cent. DDT applied at a rate of 35 U.S. gals. and a machine speed of 4 miles per hour gave successful kills in swathes extending 100 ft. horizontally and covering heights up to 15 ft. When the beetles were on high bushes or trees, it was necessary to stop momentarily near the base of the tree and direct the fog into it. For control, it appeared to be necessary to disperse 1 lb. DDT per acre.

Ashdown (D.) & Watkins (T. C.). **Control of the Lettuce Yellows Disease in New York.**—*J. econ. Ent.* **41** no. 2 pp. 252–258, 4 refs. Menasha, Wis., 1948.

The control of lettuce yellows [*Chlorogenus callistephi* var. *vulgaris* of Holmes] in New York is primarily an entomological problem, as it has been shown that the only mode of transmission of the virus in the field in that State is by means of *Macrosteles divisus*, Uhl. Pyrethrum and rotenone dusts containing sulphur, which have given good results in New Jersey [*R.A.E.*, A **27** 536] and on Staten Island [**29** 647], have not met with success or widespread use in the muckland areas of New York, as they have failed to give any appreciable reduction in transmission of the disease unless more applications were made than were economically justified. The following is based on the authors' summary of this account of field tests of other methods of control in 1946 and 1947.

Preliminary tests on the use of cloth screens to protect lettuce from attack by *M. divisus* [*cf.* **29** 647] showed that protection was necessary from the time that the plants appeared until they were well over half-grown if any appreciable control of the disease was to be effected. DDT in the form of a mechanically mixed dust proved effective when applied throughout this period. The most effective and economical dusting programme was one in which 5 per cent. DDT was used at the rate of 35 lb. per acre at five-day intervals, beginning as soon as the lettuce rows were well marked by germinating plants and continuing to within an estimated three weeks of harvest ; this resulted in DDT residues within the tolerance. Various other DDT dusts were tested but none proved superior to the regular-grind, mechanically mixed 5 per cent. dust, though impregnated dusts containing only 0·5 per cent. DDT gave comparable results. No benefits were derived from the addition of sulphur or pyrethrum to the mechanically mixed dusts, and neither rotenone nor pyrethrum with sulphur proved as effective without DDT as did DDT alone.

It was observed in 1947 that control of the disease was better in plantings in which adjacent crops differed by about three weeks in age, since the younger dusted rows served as a barrier to the leafhoppers migrating from the older ones at harvest, and that a further application after harvest but before disking greatly reduced the numbers of leafhoppers able to migrate from the crop residues at disking time. In a single test in which aircraft were used to apply DDT dust, both an aeroplane and a helicopter proved effective.

Gambrell (F. L.) & Mason (A. C.). **Insecticidal and phytotoxic Properties of Plant Dips used to control the European Chafer.**—*J. econ. Ent.* **41** no. 2 pp. 258–263, 2 figs., 7 refs. Menasha, Wis., 1948.

The results are given of experiments in New York to determine the relative effectiveness of various concentrations of ethylene dichloride and ethylene dibromide as dips against larvae of *Amphimallon majalis*, Razoum., on roots of nursery stock in soil balls wrapped in burlap, with their possible phytotoxic effect on various species of evergreens, and of these compounds and chlordan when applied to the surface of infested bare soils or seed beds. Trees were dug, balled and burlapped, and the balls, which were 8–10 ins. in diameter, were artificially infested with third-instar larvae several days before treatment. They were dipped for ten seconds in emulsive mixtures consisting of 97·5 per cent. ethylene dichloride and 2·5 per cent. Tween 20 (a polyoxyalkylene derivative of sorbitan monolaurate) or 16 per cent. ethylene dibromide, 81·5 per cent. ethylene dichloride and 2·5 per cent. Tween 20, further diluted with water, allowed to drain for 1–2 minutes and kept in compact groups at predetermined temperatures for different exposure periods. Records of mortality of the larvae at weekly intervals for three weeks showed that the highest mortality

occurred during the week following treatment and that the higher concentrations, longer exposure periods and higher temperatures appeared to favour higher kills. The ethylene-dichloride concentrate at 30 ml. per U.S. gal. caused somewhat higher mortality at the end of three weeks when the balls were kept at 60°F. than when they were kept at 40°F., but about the same when they were kept for 48 hours at 40°F. or for 24 hours at 60°F. Dosages of 20 and 30 ml. per U.S. gal. gave 96·5–99·1 and 95·7–100 per cent. kill. The concentrate containing ethylene dibromide was rather more effective at 1–5 ml. per U.S. gal. (99·4–100 per cent. mortality) than 20 ml. ethylene dichloride and killed the grubs more rapidly.

In plant tolerance tests on eight species of evergreens, the ethylene-dichloride concentrate did not appear to affect the trees adversely at a concentration of 20 ml. but caused noticeable injury to several species at 30 ml. The other concentrate caused severe injury in most cases at concentrations of 5–10 ml., but Norway spruce [*Picea abies*] showed a high survival when dipped in concentrations of 1 and 2 ml. and there is reason to expect that this emulsion may be useful as a plant dip on balled and burlapped evergreens for the control of *A. majalis*, though further experiments are necessary to establish its value definitely. Under the conditions of these tests, ethylene dichloride at 20 ml. per U.S. gal. water shows definite promise as a safe and effective treatment.

Applications to the soil surface were made at the rate of 1 U.S. gal. diluted emulsion per square yard of soil that had been infested with 200 larvae five days before, and grub mortality was determined 11 days later. The concentrate containing 16 per cent. ethylene dibromide and one consisting of 15 per cent. chlordan, 82·5 per cent. ethylene dichloride and 2·5 per cent. Tween 20 were used, and, at concentrations of 10–20 ml. per U.S. gal., the former gave 95–100 per cent. mortality, whereas the latter gave only 12·2–21·9 per cent. Transformation of larvae to the prepupal and pupal stages was very noticeable in the chlordan plots, but only one living larva and three prepupae were observed in the four ethylene-dibromide plots. Further information is necessary to demonstrate the practicability of such a method of treatment for the control of *A. majalis*.

Stearns (L. A.), Warren (J. C.) & Parker (W. L.). **Chlorinated Camphene for Control of Eastern Tent Caterpillar, Boxwood Leaf Miner and Bagworm.**—*J. econ. Ent.* **41** no. 2 pp. 264–267, 5 refs. Menasha, Wis., 1948.

The results are given of spray tests in which toxaphene (chlorinated camphene) was compared with DDT, BHC (benzene hexachloride, containing 6 per cent. γ isomer), sulphur and the recommended sprays against *Malacosoma americana*, F., *Monarthropalpus buxi*, Lab., and *Thyridopteryx ephemeraeformis*, Haw., in Delaware in 1947. All spray quantities are given per 100 U.S. gals. Sprays of 1 lb. toxaphene or DDT, applied on 23rd April to wild cherry trees on which hatching of *Malacosoma* began on 12th April, killed all the larvae within a week, the normal treatment with 3 lb. lead arsenate and 6 lb. lime and a spray of 3 lb. BHC killed 100 and 98 per cent. in two weeks, respectively, and 6–30 lb. sulphur not more than 95 per cent. in three weeks; sulphur was too slow in action to prevent extensive feeding. Sprays of 2 lb. toxaphene or DDT and the usual spray containing 20 U.S. gals. molasses and 1 U.S. quart nicotine sulphate all gave complete kills of *Monarthropalpus* when applied on 12th May to leaves of box [*Buxus*] infested with pupae. At 1 lb., DDT was slightly and toxaphene decidedly less effective. BHC was unsatisfactory. On sycamores [*Platanus occidentalis*] treated for the control of *T. ephemeraeformis* on 14th July, the usual spray of 6 lb. lead arsenate and 4 oz. soy-bean flour and a spray containing 1 lb. toxaphene gave 100 and 92 per cent. control of larvae in the first week and 61 and 59 per cent. over four weeks, respectively.

Sprays of 1 lb. DDT and 3 lb. BHC gave 64 and 40 per cent. control in the first week and 22 and 14 per cent. over four weeks, and sulphur was ineffective.

Toxaphene was applied at 0·5–4 lb. in May to the tender new growth of 52 species of deciduous trees and shrubs in Connecticut and, under midsummer conditions of high temperature and humidity, to 19 species of ornamental evergreens in Delaware. The only damage was to imperial gage plum and sugar maple [*Acer saccharum*] in May. Since foliage injury frequently results from the use of lead arsenate and the combination of molasses and nicotine sulphate is almost prohibitive in cost, it is concluded that toxaphene could be used with advantage against these three pests.

DITMAN (L. P.) & CORY (E. N.). **Liquefied Gas Aerosols to control Bean Beetles.** —*J. econ. Ent.* **41** no. 2 pp. 268–275, 3 figs., 1 ref. Menasha, Wis., 1948.

The following is largely based on the authors' discussion and summary. In experiments in Maryland in 1947 with liquefied-gas acrosols against a heavy infestation of *Cerotoma trifurcata*, Forst., and *Epilachna varivestis*, Muls., on early planted string beans and an extremely heavy infestation of *E. varivestis* on lima beans, five types of row-crop aerosol dispensers of various sizes were designed for attachment to cultivators, so that cultivation and insect control could be carried out in the same operation. These dispensers, which are described and which released the aerosols under one or two metal boxes or hoods, were simple and inexpensive to construct and provided uniform application to the plants, since cultivating had to be done with considerable accuracy. Under field conditions and when operated by farm labour, they proved to be practical, efficient and durable. No nozzle or line stoppage occurred, probably owing to the adoption of the solvent used [*cf. R.A.E.*, A **35** 256] and to the practice of allowing acetone-rotenone extracts to settle for at least 24 hours before being applied. The introduction of satisfactory filters in the feed line eliminated iron rust and other solid matter from the aerosol solutions.

The aerosol solutions used were based on a formula of DDT, Velsicol AR-60, acetone and methyl chloride (5 : 10 : 35 : 50), acetone extracts of cubé, derris and pyrethrum being included at the expense of acetone and small amounts of carbon dioxide being used to replace part of the methyl chloride propellant to increase the pressure in some solutions.

All the aerosols tested were highly effective against adults of *C. trifurcata*, but only those with a comparatively high pyrethrum content and those containing rotenone were effective against adults and larvae of *E. varivestis*. Those containing methoxy-DDT instead of DDT and others containing small quantities of pyrethrum with synergists had little effect against *E. varivestis*. The degree of control secured with both pyrethrum and rotenone aerosols varied with the coverage, particularly when large numbers of larvae were present. It was excellent when the plants were small, but diminished when they grew and *E. varivestis* was present in all stages of development. It appeared from the data secured and from frequent observation of fields treated in all stages of growth that treatments should be applied early so as to reduce or eliminate the adult population before oviposition occurs. Neither the aerosols nor sprays of 5 per cent. rotenone emulsion in water (1 : 400 or 1 : 200) had any apparent effect on eggs or pupae, and larvae moulting just after treatment also appeared to survive.

The most practical aerosol formula from the standpoint of cost and effectiveness was one containing 5 per cent. DDT and 10 per cent. cubé extract (20 per cent. resins); its effectiveness was only slightly enhanced and its cost considerably increased by doubling the amount of rotenone present. Methyl chloride proved to be a satisfactory propellant and was used in nearly all aerosol formulations in Maryland in 1947, both in experimental work and for

commercial treatments of peas and beans. No deleterious effects were experienced by the operators of the dispensers or the field men. The addition of carbon dioxide, which increases the pressure of the solution and the rate of application for any given size of nozzle, was of questionable value, and until similar formulae with and without it are compared at the same rate of application, conclusions cannot be drawn.

PARKER (W. L.), WARREN (J. C.) & STEARNS (L. A.). **Chlorinated Camphene on Potatoes.**—*J. econ. Ent.* **41** no. 2 pp. 275–277, 2 figs. Menasha, Wis., 1948.

In preliminary tests in 1945, toxaphene and DDT gave equal control of *Empoasca fabae*, Harr., on potato in Delaware when applied at the same rate. In 1947, these compounds were compared alone and with zinc dimethyldithiocarbamate, zinc ethylene bis(dithiocarbamate) and copper oxychloride for compatibility with these fungicides and effectiveness against insects attacking potato. No infestation of *E. fabae*, Aphids or Colorado beetle [*Leptinotarsa decemlineata*, Say] developed, but *Epitrix cucumeris*, Harr., was abundant. Sprays were applied on 27th May, 5th, 10th and 25th June and 2nd and 16th July at rates varying from 75 to 200 U.S. gals. per acre according to the size of the plants. A wettable powder containing 25 per cent. toxaphene, and emulsion concentrates consisting of 32 per cent. DDT or toxaphene, 65 per cent. Velsicol AR-60 and 3 per cent. Triton X-100 by weight were used in them at concentrations of 4 lb. and 1·3 U.S. quarts, respectively, per 100 U.S. gals.

Both compounds proved compatible with the fungicides, and they gave approximately equal control of *E. cucumeris*. No difference could be detected in the size, colour or development of the plants under the various treatments during the early part of the growing season, but untreated plants and those receiving the fungicides alone were dead by 22nd July, whereas those receiving both fungicide and insecticide or insecticide alone remained green until they were dug on 5th August. The yields in bushels of marketable potatoes per acre were 425, 359, 398 and 460 for the emulsion containing DDT, alone and with the three fungicides, respectively, 463, 322, 384 and 419 for the emulsion containing toxaphene alone and with the fungicides, 369 for the wettable toxaphene powder, 266, 307 and 292 for the three fungicides alone, and 297 for no treatment ; the difference required for significance was 38 bushels. All the plants receiving an insecticide averaged less than 0·5 flea-beetles per leaf, those treated with fungicides only averaged approximately 3·5 per leaf and untreated ones 6·29.

In plant toxicity tests on potted potatoes in which the same preparations of DDT and toxaphene were used, and also concentrates containing 50 per cent. of either with Shell E-407 as solvent and Tween G-1045 as emulsifier, no injury was caused by any preparation at a concentration giving 1 lb. toxicant per 100 U.S. gals. and injury at higher concentrations (2 and 4 lb. toxicant) was caused only by the two formulae containing Velsicol AR-60 and was probably due to it.

ANDERSON (L. D.) & HOFMASTER (R. N.). **Pea Aphid Control Experiments in Virginia in 1947.**—*J. econ. Ent.* **41** no. 2 pp. 278–282, 1 ref. Menasha, Wis., 1948.

The following is based on the authors' summary of this account of experiments on the control of *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) on peas in Virginia in 1947. Good control (about 95 per cent.) was obtained with dusts containing 0·5, 1 and 2 per cent. DDT and 2 per cent. oil (Velsicol AR-60), whether the DDT was dissolved in the oil and then mixed with pyrophyllite or the oil was added after the diluent, but 2 per cent. DDT dust without oil was rather less

effective. An emulsion of 1 quart 25 per cent. DDT concentrate in 100 gals. water was as effective as the oil dusts ; an aerosol from a solution containing 8 per cent. each of DDT, cyclohexanone, Velsicol AR-60 and methyl chloride, 56 per cent. acetone and 12 per cent. carbon dioxide was equally effective, and one from 5 per cent. each of DDT, cyclohexanone and Velsicol AR-60, 35 per cent. acetone and 50 per cent. methyl chloride rather less so. BHC (benzene hexachloride) in dusts containing 0·5–1 per cent. γ isomer also gave good control. BHC and DDT dusts from several different sources were equally effective, and variations in particle size from five to 60 microns for the DDT and BHC concentrates had little effect on the toxicity of the finished dusts.

Dusts containing 1 per cent. rotenone or 0·25 per cent. parathion and sprays containing 0·125 per cent. HETP (hexaethyl tetraphosphate) or an emulsion of pyrethrum extract with a synergist gave poor control. When applied by aeroplane, a dust of DDT and oil gave good control and a concentrated DDT spray applied at 0·33 U.S. gals. (1 lb. actual DDT) per acre gave good control in one test, while in another, this and sprays of BHC (3 U.S. gals. spray containing 0·3 lb. γ BHC per acre) and HETP (3 U.S. gals. spray containing 1 lb. pure compound per acre) gave no control. In additional tests of aerosols, those containing 5–8 per cent. DDT or 5 per cent. γ BHC gave approximately 94 per cent. control, 2·5 per cent. γ BHC gave 89 per cent., 10 per cent. HETP gave 90 per cent. control with oil and 83 per cent. without, and 5 per cent. chlordan and 5 per cent. toxaphene gave only 72 and 68 per cent., respectively.

Some foliage injury occurred when BHC was used as a spray or aerosol, and both this compound and HETP were disagreeable to handle. BHC imparted no odour or taste to the harvested peas.

Roth (R. W.). **Compatibility of DDT with commercial Limes.**—*J. econ. Ent.* **41** no. 2 pp. 282–287, 4 figs., 3 refs. Menasha, Wis., 1948.

The following is based on the author's summary. A laboratory technique is described for the study of the effects on DDT of commercial forms of hydrated lime and the component parts or reaction products of lime when mixed and stored in a dry state at normal temperatures. It was found by analytical methods that pyrophyllite, calcium carbonate and a high-magnesium lime produced little breakdown of DDT over a 16-day period, whereas magnesium oxide caused breakdown, but not at a rapid rate. Calcium hydroxide and a high-calcium lime caused rapid and almost complete breakdown of DDT during storage for 16 days at 78°F. A similar study, in which DDT was mixed with ten commercial limes, indicated a wide variation in reactivity of the various limes in causing breakdown of DDT. This dehydrohalogenation of DDT by the lime was closely correlated with loss of toxicity to *Macrosiphum solanifolii*, Ashm., of sprays prepared from extracts of the mixtures.

Sherman (M.) & Norton (L. B.). **The Bioassay of Gamma Benzene Hexachloride.**—*J. econ. Ent.* **41** no. 2 pp. 288–292, 2 figs., 8 refs. Menasha, Wis., 1948.

Owing to the difficulty of determining the γ isomer content of benzene hexachloride, a method of bioassay was developed. Adults of *Tribolium castaneum*, Hbst., were found to be well suited as test insects, as they are easily reared and, unlike some other insects, not susceptible to the δ isomer, while the toxicity curve for the γ isomer was so steep that the assay would be very precise. Acetone solutions containing the required concentrations of the materials to be tested were prepared, and 1 ml. solution was thoroughly mixed with 1 gm. finely ground whole wheat meal in a biological specimen dish, the acetone

allowed to evaporate and the mixture spread over the bottom of the dish ; 100 beetles 1–2 months old were added to each dish, the dishes covered with cheesecloth, and the insects examined after eight days. The temperature was about 78°F. The MLD (median lethal dose) of the γ isomer was determined in this way as 0·146 mg. per gm. meal in 1946 and as 0·142 in 1947, showing the reproducibility of the curves, and the toxicities of the impurities and other isomers were relatively low.

In tests with technical benzene heptachloride and each of the five known isomers of benzene hexachloride, there was negligible mortality from the α, δ and ε isomers at doses 700 times as high as the MLD for the γ isomer and from the β isomer at 350 times the MLD. The benzene heptachloride showed significant toxicity, but its MLD was only about 0·5 per cent. of that of the γ isomer. It should therefore cause no interference in the assay, since its concentration in commercial samples is normally less than that of the γ isomer. Comparison of mixtures of benzene heptachloride and the α, β, γ, δ and ε isomers of benzene hexachloride in equal quantities and in the proportions found in a typical commercial sample (4 : 70 : 5 : 10 : 6 : 4) gave no indication that the toxicity of the γ isomer was affected by the other constituents.

In an assay of eight samples of commercial benzene hexachloride, the mortalities in probits for each were plotted against the logarithms of the dosages, and a line equal in slope to the standard γ regression line was drawn through them. The log-ratio of the potency of each material and its standard error were determined statistically, and from these the apparent γ content and the range within which it could be expected to fall in 99 out of 100 assays was calculated. The apparent γ contents obtained by graphic comparison were very close to the values obtained by statistical computation and should be sufficiently accurate for most purposes. In a comparison of the results with analyses of the eight materials by the infra-red absorption method, three determinations agreed within the experimental error and five were significantly higher by the bioassay method. Further investigations are needed to determine which is the more accurate. Ways of increasing the precision of the bioassay are suggested.

Menusan jr. (H.). **Comparative Toxicity of Insecticides administered in various Ways to several Species of Insects.**—*J. econ. Ent.* **41** no. 2 pp. 302–313, 15 refs. Menasha, Wis., 1948.

The following is based on the author's summary. The insecticidal activity of various materials was tested against *Periplaneta americana*, L., by blood-stream injection, by contact and by oral feeding. The dosage of insecticide needed for contact toxicity was usually about twice the amount that was toxic when injected. Pyrethrum was the only material that was equally toxic by contact and by injection. There was a striking similarity in the reaction of the cockroach to contact and stomach poisons. Materials not toxic by contact were not toxic when administered orally, and those that were toxic by contact were toxic as stomach poisons also. The minimum dosage that was toxic by feeding was usually considerably higher than the minimum dosage of the same material that was toxic by contact. Differences in resistance between the sexes varied with the insecticide used and the method of testing. The female was always more resistant than the male except to dichlorethyl ether. Differences between the sexes were smallest in the tests by injection into the blood stream. In these, the resistance of the female averaged 1·6 times that of the male. In contact and feeding tests, the resistance of the female averaged 3–4 times that of the male. The administration of predetermined dosages to individual insects increased the accuracy of the evaluation of insecticidal effectiveness. On account of the differences in resistance, it is important either to test the sexes separately or to be sure that they are represented in equal numbers.

Tests of toxicity by injection and by contact were also made against other insects, which varied greatly in susceptibility. The forms used in order of increasing resistance were larvae of *Bombyx mori*, L., larvae of *Ceratomia catalpae*, Boisd., adults of *P. americana*, adults of *Anasa tristis*, Deg., and adults of *Popillia japonica*, Newm. Two other insects were used in tests of contact toxicity only. These were adults of *Oncopeltus fasciatus*, Dall., which appeared to be more susceptible than *Periplaneta americana*, and adults of *Tenebrio molitor*, L., which was as resistant as *Popillia japonica*.

SCHREAD (J. C.). **Control of Soil Insects.**—*J. econ. Ent.* **41** no. 2 pp. 318–324, 2 refs. Menasha, Wis., 1948.

Comparative tests with DDT, toxaphene, BHC (benzene hexachloride), chlordan and parathion were carried out in Connecticut during 1947 against insects in turf.

Applications to the turf on 12th May of 8, 12, 16, 20 or 24 lb. toxaphene per acre in a 10 per cent. dust, further diluted with fertiliser, prevented maximum injury by larvae of the Japanese beetle [*Popillia japonica*, Newm.] in early June and had killed almost all the larvae that hatched during the summer by late September. A 50 per cent. wettable BHC powder (6 per cent. γ isomer) applied at 0·96–4·8 lb. γ isomer in 1,200 U.S. gals. water per acre on 15th May checked serious turf injury in June and gave almost complete control of larvae by late September. Neither material prevented oviposition, and the BHC left a musty odour for several months. Applications of 8–24 lb. chlordan per acre as a 2 per cent. dust on 20th May caused a high apparent reduction of overwintering larvae four weeks after treatment and killed the larvae that hatched during the summer and also, apparently, a large proportion of the adults attempting to oviposit, though it did not completely prevent oviposition. Chlordan applied at 10 lb. per acre in a 10 per cent. dust on 13th August gave 93·2 per cent. mortality of larvae in 14 days and over 99 per cent. by 14th September ; when it was applied at 10 lb. per acre in a 5 per cent. dust on 17th September and the turf was subsequently watered and rolled every day for several days, it immobilised a heavy grub population in two days, killed 96 per cent. in ten days, and resulted in the saving of 95 per cent. of the turf. Treatment with chlordan increased the vigour of turf and deepened its colour. Parathion applied at 1, 4 and 8 lb. per acre in 0·25, 1 and 2 per cent. dusts (400 lb. dust per acre) on 22nd August and watered in with 1,600 U.S. gals. water per acre gave high control of the larvae in 4, 2 and 2 weeks, respectively, and the same treatments applied on 17th September and watered in with 50 per cent. more water all gave adequate control in two weeks. Soil analyses showed that the toxicant persisted longest in the soil in autumn, when soil and air temperatures were lower than in summer. No foliage injury was observed.

Comparison of these results with those obtained from applications of 25 lb. DDT per acre showed that chlordan acts more quickly and gives more complete control than DDT, toxaphene or BHC and that parathion is apparently even more effective. Toxaphene at 16 and 24 lb. per acre, chlordan at 10 lb. per acre and parathion at 1 lb. per acre were all more effective than DDT at 25 lb. per acre.

Lasius niger americanus, Emery, was controlled in turf by applying a small quantity of chlordan to the centre of each ant hill either as a powder that was watered in or as an aqueous suspension, or by watering the turf with a suspension of 4 oz. 50 per cent. wettable chlordan in 75–100 U.S. gals. water per 1,000 sq. ft. and subsequently with water. These treatments eliminated the colonies and prevented re-establishment for 3–6 weeks, after which treatment could be repeated if necessary. Colonies of *Formica exsectoides*, Forel, were completely

destroyed in a few days and showed no signs of activity after 50 days when treated with 1–8 oz. 50 per cent. wettable chlordan per nest, depending on its size, in July or August, and workers that were dusted with chlordan or put in cages that had been lightly dusted on the floors with this compound were killed in 5–6 hours. *F. pallidefulva nitidiventris*, Emery, and *F. fusca subsericea*, Say, working in open soil at the base of shrubs and in turf, were successfully controlled when chlordan was applied as a fog to the openings of their nests.

In preliminary experiments, *Blissus leucopterus*, Say, was eliminated from turf by 5 per cent. chlordan dust applied at the rate of 6–10 lb. per 1,000 sq. ft. The lowest dosage was as effective as the highest.

Woodside (A. M.). **DDT for Ant Control in Lawns.**—*J. econ. Ent.* **41** no. 2 pp. 325–326. Menasha, Wis., 1948.

The results are given of tests with DDT for the control of *Formica fusca subsericea*, Say, and *Lasius niger neoniger*, Emery, in lawns in Virginia. Plots one yard square were treated with 2·5 or 5 gm. DDT prepared by mixing a 50 per cent. preparation with 1 U.S. quart water or diluting it with talc to form a 10 per cent. dust, and ants on the surface were counted immediately before treatment and 1–7 weeks after it. Ant activity declined steadily and had ceased after five or seven weeks on all the plots except one sprayed with 2·5 gm. DDT. The ants on this plot seemed to come from many nests under a low stone wall near one side of the plot, and when a liberal amount of DDT was applied along the base of the wall, all activity soon ceased. Before treatment, nests were so common that no grass and little other vegetation could grow, but at the final examination grass and weeds had covered the surface of the treated plots, whereas untreated areas were still almost bare. Treatments were also applied in a vegetable garden. Dusts and sprays of DDT were about equally effective, but sprays gave quicker results. Dusts were more quickly effective when mixed with the soil about a nest entrance than when sprinkled on the surface, and also when the application was followed by a shower.

On 17th July, DDT was applied in dusts and sprays at rates of 1, 2, 4 and 8 gm. per sq. yd. to plots on a lawn infested with *Lasius*, and on 8th August the three lower dosages were applied to additional plots. The mounds on each plot were counted and levelled after the DDT was applied, and rebuilt mounds, indicating reopened nests, were counted at weekly intervals for five weeks. There was a gradual decline in ant activity in the treated plots. This was slightly more rapid in sprayed than in dusted plots, but the difference was insignificant. The heavier dosages resulted in a more rapid reduction in activity, but even the dosages of 1 gm. per sq. yd. (2·45 lb. 10 per cent. DDT per 1,000 sq. ft.) resulted in an almost complete absence of activity in five weeks. After eight weeks there was no sign of activity in any of the treated plots.

Bromley (S. W.). **Tests on Control of Elm** *Scolytus*.—*J. econ. Ent.* **41** no. 2 p. 327. Menasha, Wis., 1948.

Laboratory tests were carried out in Connecticut in 1947 to compare the efficiency of lead arsenate and DDT in preventing crotch feeding on elm by *Scolytus multistriatus*, Marsh., a vector of Dutch elm disease [*Ceratostomella ulmi*]. Small potted elm trees were caged and sprayed with 6 lb. lead arsenate or 2 lb. 50 per cent. wettable DDT per 100 U.S. gals. on 13th June or treated with 1 lb. 89 per cent. DDT crystals dissolved in 3 U.S. pints xylene, diluted with 5 U.S. pints kerosene and applied as a mist on 7th July, and newly emerged beetles were introduced into the cages at the rate of 20 every day or every other day throughout the emergence period. The beetles immediately went to the twig crotches and began to feed, but it was nine and 21 days before

they penetrated to the sapwood on the trees sprayed with lead arsenate and DDT, respectively. Lead arsenate killed the beetles less rapidly than DDT, but both materials gave protection throughout the season with a minimum of foliage injury. The tree receiving the mist spray died within three weeks as a result of kerosene penetrating the tender bark. An untreated tree was exposed to eight beetles, which killed it nearly down to the ground in ten days. Adults of *Eutetrapha* (*Saperda*) *tridentata*, Ol., were apparently unaffected by the DDT, some of them surviving for as long as ten days in the cage, whereas they were killed by lead arsenate within a few hours after introduction.

It is concluded that sprays of lead arsenate or wettable DDT can give satisfactory protection from crotch feeding by *S. multistriatus*. A fair amount of protection was obtained in large-scale outdoor applications of sprays of DDT from a mist blower in 1947, but there was considerable oil injury on many elms treated in this way. A survey of some 700 trees in south-western Connecticut, Westchester County, New York, and New Jersey that had been well cared for and sprayed with lead arsenate once or twice a season, showed that only five had died during the past ten years from Dutch elm disease and attack by *Scolytus*, whereas 25 per cent. of the elms in the streets and parks of one Connecticut city, where they had been rather neglected, had died from these causes in 18 years.

Turner (N.) & Woodruff (N.). **Chlorinated Insecticides for Control of the Potato Flea Beetle.**—*J. econ. Ent.* **41** no. 2 pp. 328–329, 6 refs. Menasha, Wis., 1948.

In further tests on the control of the potato flea-beetle [*Epitrix cucumeris*, Harr.] on potato in Connecticut [*cf. R.A.E.*, A **36** 328], sprays of 0·125, 0·25 and 0·5 lb. DDT in a finely micronised powder, 0·125, 0·25, 0·5 and 1 lb. DDT in a ball-milled dust or in emulsified solutions and 0·25, 0·5 and 1 lb. methoxy-DDT, chlordan or toxaphene in wettable powders per 100 U.S. gals. were applied at weekly intervals between 4th June and 1st August. Damage by overwintered and first-generation adults was estimated on 18th June and 24th July, respectively, and the yields were estimated at harvest in October; there were no significant differences in yield between treated and untreated plants, as the flea-beetle was the only serious pest present. The finely micronised DDT resulted in significantly better control than the coarse powder [*cf. loc. cit.*] or any of the other preparations. Toxaphene caused marked foliage injury when used at the highest concentration, and yields following the use of this material at all concentrations or methoxy-DDT at the two higher ones were lower than those from no treatment.

Kerr jr. (T. W.). **A *Phyllobius* Species, a new Pest and its Control on Arborvitae.**—*J. econ. Ent.* **41** no. 2 pp. 331–332. Menasha, Wis., 1948.

Severe injury by some insect to the roots of arborvitae (*Thuja occidentalis*) in a nursery in Rhode Island was reported in late April 1947, and on 5th May a few larvae and many pupae of an undetermined species of *Phyllobius* and a few pupae of *Barypeithes pellucidus*, Boh., were found in the soil round the roots. Pupae of both species transformed to adults within 72 hours when kept at room temperature in the laboratory. In the field, a few *Phyllobius* adults appeared during the middle of May and all had emerged by 26th May. Both sexes were present until 16th July, but they were rarely seen in flight, particularly after late May, and the weevil is probably disseminated chiefly in balled nursery stock. They fed on the newly formed leaves of arborvitae, generally at the terminal end of branches on the top third of the plant. They remained on the

foliage at night, but it was not determined whether they fed then. They were also taken on species of *Juniperus* and *Chamaecyparis*. No eggs were found in the field, but caged adults laid eggs singly, or occasionally in groups of 2–5, at a depth of 2–3 mm. in the soil. These hatched in 10–11 days at 73–77°F., but failed to hatch at 80°F. In the field, larvae in the earlier instars were not found until 6th October 1947, when they were feeding on the roots of arborvitae with larvae of *Otiorrhynchus* (*Brachyrrhinus*) *ovatus*, L., and *Barypeithes* sp.

In field tests, sprays of 3 lb. lead arsenate, 2 lb. 50 per cent. wettable benzene hexachloride (6 per cent. γ isomer) and 2 lb. 50 per cent. wettable DDT per 100 U.S. gals. water applied to heavily infested arborvitae on 27th May, gave 31·7, 98 and 99·8 per cent. reduction, respectively, in adults of *Phyllobius* after two days and 88, 97·5 and 100 per cent. after 17 days, whereas the numbers on untreated plots had increased by 2·4 per cent. after two days and decreased, owing to natural mortality, by 82·3 per cent. after 17 days.

Anderson (L. D.) & Hofmaster (R. N.). **Control of Pickleworms on Cucumbers and Cantaloupes.**—*J. econ. Ent.* **41** no. 2 pp. 334–335, 1 ref. Menasha, Wis., 1948.

Further tests of dusts of DDT and BHC (benzene hexachloride) for the control of *Diaphania nitidalis*, Stoll [*cf. R.A.E.*, A **36** 331] were carried out in Virginia in 1947. Cucumbers and cantaloupe melons set out on 2nd August were treated on that date with an oil-impregnated dust containing 1 per cent. DDT against the striped cucumber beetle [*Diabrotica melanocephala*, F.], which was completely controlled by it, and dusts containing 3 per cent. DDT, 1 per cent. DDT with 2 per cent. oil, 5 per cent. DDD or 0·5 or 1 per cent. γ BHC were applied to the cucumbers on 12th and 18th September and to the melons on those dates and 26th October for the control of *Diaphania*. All reduced the percentage of infested cucumber fruits from 80 to 0·5–3 and increased the number of marketable cucumbers per plot from 27 to 89–109, with no significant difference between treatments. The cucumbers from plants treated with 1 per cent. γ BHC were significantly smaller than any others, because the foliage was scorched, and slight foliage injury occurred on cucumber plants treated with the 0·5 per cent. dust, but not on any others. On 6th October, no treated melons had more than 3 per cent. infested fruits, with no significant differences between treatments, whereas untreated ones had 52 per cent. By 27th October, melons treated with DDD and DDT had still only 2 and 7–8 per cent. infested fruits, respectively, but those treated with BHC had significantly more (18–19 per cent.) and untreated ones had 65 per cent.

Stanley (W. W.). **Amount of Dew found on Leaf Surfaces.**—*J. econ. Ent.* **41** no. 2 p. 336, 1 ref. Menasha, Wis., 1948.

The amount of dew that forms on plants is of importance in the application of dusts or sprays. In experiments in Tennessee, the total amount found on the morning of 4th May on steel triangles exposed overnight was equivalent to 55 U.S. gals. water per acre and there was more on the upper than the lower surface. Cabbages had moisture equivalent to about 325 U.S. gals. per acre on the leaves on the morning of 25th May, some of it possibly due to guttation, and bean leaves had 84 and 72 U.S. gals. per acre on the upper and lower surfaces, respectively, on 11th August. Since beans may have 10·2 acres of foliage per acre of ground surface, 1,591 U.S. gals. water may be present on the bean foliage on one acre of ground. This is equivalent to about 0·08 in. rain.

Petty (B. K.). **Residual Toxicity of chlorinated Hydrocarbon Insecticides.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 291, [1+] 15 pp., 3 refs. Pretoria, 1948.

The results are given of investigations in South Africa of the persistence on surfaces commonly used in household construction of toxic residues left by DDT [*cf. R.A.E.*, A **37** 179], BHC (benzene hexachloride) or chlordan when applied in sprays and of DDT, BHC and pentachlorphenol applied as smokes. The test insects were workers of *Eutermes* (*Trinervitermes*) *havilandi*, Fuller, and they were confined on the surfaces 24 hours after these had been treated and subsequently at monthly intervals ; they were exposed for 24 hours and then transferred to clean petri dishes containing moist filter paper. Knockdown was recorded during the first six hours of exposure, and mortality at the end of it and subsequently at 24-hour intervals until all the insects had died or recovered from the effects of the insecticides.

The sprays were kerosene solutions applied by an apparatus already noticed [**37** 178] to give deposits of 3·6 mg. p,p'DDT, γ BHC or pure chlordan per sq. ft., and the surfaces in the first series of tests were unpainted wood, wood that had been coated with white enamel paint or distemper four months earlier, glass and filter paper. BHC produced a markedly faster rate of knockdown than either DDT or chlordan on all surfaces 24 hours after application and was the only one to cause knockdown on enamel paint [*cf.* **37** 179], on which it caused 92·5 per cent. knockdown followed by only 2 per cent. mortality. Insects knocked down by DDT or chlordan on any surface rarely recovered, and DDT gave complete mortality even where no knockdown occurred in six hours. Mortalities due to all treatments on enamel paint were very low (0–5·9 per cent.) and showed no evident reduction with age of deposit during the 12 months of the experiment. Initial mortalities on the other four surfaces were 100 per cent. for BHC and chlordan and 98–100 per cent. for DDT, but whereas BHC and chlordan had become relatively ineffective 1–2 months after application, DDT deposits were still highly toxic on filter paper and caused appreciable mortality on distemper and glass after ten months ; deposits on unpainted wood were much less durable. It is suggested that the superiority of filter paper is due to its soft, fibrous nature. The constant movement of the insects on it wears away the superficial fibres and exposes the DDT crystallised below the surface. Chlordan and BHC also gave their best results on filter paper, followed by distemper.

Experiments in which the sprays were applied to wood that had been coated with distemper six hours or four months earlier showed that they were all considerably less effective on fresh distemper than on old ; BHC was the most toxic of the three on fresh distemper. No mortality resulted from deposits on surfaces coated with enamel paint one month earlier, but those on enamel paint two years old were reasonably effective 24 hours after application, though their effectiveness was nearly all gone after a month ; DDT gave the best results.

The smokes were generated by igniting a mixture of 52 per cent. DDT, BHC or pentachlorphenol, 12 per cent. potassium chlorate and 36 per cent. sugar in a container holding 400 gm., and 60–70 per cent. of the toxic ingredient was recoverable from them. Each container was used in a room with a capacity of 1,500 cu. ft., and the various surfaces were exposed for 2½ hours. Examination of glass plates exposed at the same time showed that the deposits produced by DDT and pentachlorphenol consisted of minute droplets and that by BHC of finely divided solid particles. The deposits were not measured, but it was evident that the containers were too large for the room used and would have sufficed for one of 20,000 to 30,000 cu. ft. Tests in which unpainted wood was exposed in a horizontal position at ground level and at heights of 3, 6 and 8 ft. and in a vertical position at 3 ft. showed that vertical surfaces do not retain the deposits so well as horizontal ones ; DDT was slightly more effective on them than the other two materials. The deposits from DDT and pentachlorphenol

smokes remained highly effective and gave about equal mortalities for the 18 months of the test on horizontal surfaces, whereas BHC was effective for only slightly more than four weeks. The knockdown rate of pentachlorphenol was higher than that of DDT for four months after application, about equalled it for the next two months, and then deteriorated rapidly. There was some evidence that horizontal surfaces at ground level and at 6 ft. received heavier deposits than those at 8 ft. Similar experiments to compare the persistence of DDT smoke deposits on plain wood and wood painted or distempered four months previously showed that those on oil and enamel paints became ineffective in less than a month, whereas those on wood and distemper remained highly toxic throughout two years of experiment; persistence was greater on distemper than on wood.

BARNES (H. F.). **Gall Midges of economic Importance. Vol. VI. Gall Midges of miscellaneous Crops.** —$8\frac{3}{4} \times 5\frac{1}{2}$ ins., 229 pp., 14 pls., refs. London, Crosby Lockwood & Son, Ltd., 1949. Price 15*s*.

This sixth volume of a series on Cecidomyiids of economic importance, of which the first four but not the fifth have already appeared [*R.A.E.*, A **37** 114, etc.], deals with those that attack miscellaneous plants, including bamboos, basket willows, *Ceratonia siliqua*, herbs, and plants grown for the production of beverages, dyes, fibres, insecticides, oil, rubber and spices. Each section resembles the other volumes in scope and arrangement, and a summary by H. C. F. Newton of investigations on the factors governing the selection of food-plants by *Rhabdophaga heterobia*, Lw., which attacks willows in Britain and France, is appended.

Specifications and Methods of Analysis for certain Insecticides and Fungicides.—*Tech. Bull. Minist. Agric.* no. 1, 63 pp. London, 1949.

This bulletin, which replaces two previous ones [*R.A.E.*, A **22** 602; **30** 96], contains specifications for certain materials and methods of analysing them drawn up by joint committees of the Ministry of Agriculture and the Association of British Insecticide Manufacturers in connection with the standardisation of insecticides and fungicides in Britain. The materials dealt with are copper sulphate, lime-sulphur solution, formaldehyde, metaldehyde, nicotine, nicotine sulphate, lead arsenate powders and pastes, Paris green, winter washes of the miscible and stock emulsion types containing tar oil or tar oil and petroleum oil, petroleum oil winter and summer washes of the miscible and stock emulsion types and winter washes of dinitro-o-cresol in petroleum oil. Specifications for some other materials used in the analyses and instructions for preparing freezing mixtures and several reagents also required for them are given in an appendix.

PAPERS NOTICED BY TITLE ONLY.

List of United States Patents granted Members of the Division of Insecticide Investigations, R. C. Roark, in Charge, for the Period July 1, 1927 to June 30, 1947.—24 pp., multigraph. [Washington, D.C.] U.S. Dep. Agric. Bur. Ent., 1947.

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The Institute will be greatly indebted to readers who may be able to supply any of the following, which should be sent to the Director, Commonwealth Institute of Entomology, 41, Queen's Gate, London, S.W.7.

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